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TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 68.

ANNUAL MEETING.

Held in Chipman Hall, 88 Tremont Street, Boston, Mass.,

APRIL 25-26, 1900.

Office of the Association:

Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY.
1900.

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NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

Membership of

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body it must include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.

New England Cotton Manufacturers' Associatic

Room 57, International Trust Building,

45 MILK STREET,

BOSTON, MASS.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. .....

Position, ...

P. O. Address, ...

is proposed for ..... *membership in the* NEW ENGLAND COTTON
active or associate]

MANUFACTURERS' ASSOCIATION *by* .....
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full, particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

.....

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.....

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The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 190 .

.....
signature of candidate.

atio

ng,

P.

L. M. Thompson.

TRANSACTIONS

OF THE

New England

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Founded April 20, 1865. Incorporated Dec. 1, 1894.

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Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:

PRESS OF E. L. BARRY.

1900.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1900
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,
Secretary of the Commonwealth.

157068

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1900.

PRESIDENT.

D. M. THOMPSON, ... PROVIDENCE, R. I.

VICE-PRESIDENTS.

CHARLES H. RICHARDSON, . . CLINTON, MASS.
GEORGE H. HILLS, ... FALL RIVER, MASS.

DIRECTORS.

ALFRED E. ADAMS, ... WHITINSVILLE, MASS.
CHARLES H. FISH, ... DOVER, N. H.
JOHN TEMPEST MEATS, . . . TAUNTON, MASS.
HERBERT E. WALMSLEY, . . . NEW BEDFORD, MASS.
A. TENNY WHITE, ... MANVILLE, R. I.
GEORGE F. WHITTEN, . . . MANCHESTER, N. H.

AUDITOR.

C. E. ROBERTS, ... BOSTON, MASS.

SECRETARY.

C. J. H. WOODBURY, P. O. Box 3672, BOSTON, MASS.

OFFICE OF THE ASSOCIATION:

ROOM 57, INTERNATIONAL TRUST BUILDING, 45 MILK STREET, CORNER OF DEVONSHIRE STREET, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Robert McArthur,	1892–94
Amos D. Lockwood,	1878–80	Edw. W. Thomas,	1894–95
John Kilburn,	1880–83	A. M. Goodale,	1895–96
William C. Lovering,	1883–85	Arthur H. Lowe,	1896–97
Richard Garsed,	1885–86	Russell W. Eaton,	1897–98
J. S. Ludlam,	1886–88	Stephen A. Knight,	1898–99
Henry F. Lippitt,	1888–89	Frederick E. Clarke,	1899–
Walter E. Parker,	1889–92	D. M. THOMPSON,	1900–

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Arnold B. Sanford,	1888–91
William A. Burke,	1865–73	Robert McArthur,	1889–92
John C. Palfrey,	1873–76	Simeon B. Chase,	1891–93
Edward Atkinson,	1876–78	E. W. Thomas,	1892–94
A. G. Cumnock,	1877–80	A. M. Goodale,	1893-95
Charles Nourse,	1878–81	William J. Kent,	1894–97
William F. Goulding,	1880–83	Fred. C. McDuffie,	1895–00
Richard Garsed,	1881–85	Henry T. Whitin,	1897–00
J. S. Ludlam,	1883–86	C. H. RICHARDSON,	1900–
Walter E. Parker,	1885–89	GEORGE H. HILLS,	1900–
Richard B. Borden,	1886–88		

DIRECTORS.

J. S. Davis,	1865–69	D. J. Johnston,	1869–70
Charles Nourse,	1865–78	A. G. Cumnock,	1869–77
Phineas Adams,	1865–74	F. E. Clarke,	1869–75
William P. Haines,	1865–69	S. S. Spencer,	1887–90
Thomas J. Borden,	1865–78	E. W. Thomas,	1888–92
Daniel D. Crombie,	1865–68	William W. Whitin,	1888–93
Cyrus I. Barker,	1875–80	Robert R. Smith,	1889–92
Hervey Kent,	1877–81	Alfred M. Goodale,	1890–93
David J. Johnston,	1878–82	William J. Kent,	1891–94
Walter Paine, 3d,	1878–80	Herman F. Straw,	1891–93
Chas. L. Lovering,	1878–83	Fred C. McDuffie,	1892–95
Richard Garsed,	1880–81	George W. Bean,	1892–95
William H. Jennings,	1880–83	F. M. Messenger,	1893–95
Chas. D. McDuffie,	1881–83	Arthur H. Lowe,	1894–96
Walter E. Parker,	1881–85	Henry T. Whitin,	1894–97
John W. Danielson,	1881–85	Herbert L. Pratt,	1895–98
William E. Barrows,	1882–83	Stephen A. Knight,	1895–98
Rufus A. Maxfield,	1883–86	Russell W. Eaton,	1896–97
George W. Weeks,	1883–86	Albert F. Knight,	1893–99
Henry S. Howe,	1883–87	John Eccles,	1895–99
Richard B. Borden,	1883–86	C. H. Richardson,	1897–00
O. S. Brown,	1885–91	George H. Hills,	1897–00
Henry F. Lippitt,	1885–88	JOHN T. MEATS,	1898–
Wilbur A. Stiles,	1886–88	GEO. F. WHITTEN,	1898–
Stephen N. Bourne,	1886–91	A. TENNY WHITE,	1899–
John Kilburn,	1870–80	ALFRED E. ADAMS,	1899–
William P. Haines,	1874–78	H. E. WALMSLEY,	1900–
Robert McArthur,	1886–89	CHARLES H. FISH,	1900–
A. M. Wade,	1868–69		

AUDITORS.

Benjamin Saunders,	1865–71	J. Herbert Sawyer,	1882–00
John C. Palfrey,	1871–73	C. E. ROBERTS,	1900–
Henry D. Sullivan,	1873–82		

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

Apr. 26, 1900.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

George Arms	Grand Hotel	New York City	Oct. 16, 1872.
Jones S. Davis	6 Newton St.	Holyoke, Mass.	Oct. 27, 1897.
Ambrose Eastman	53 State St.	Boston, Mass.	Sept. 27, 1894.
Moses Pierce	274 Broadway	Norwich, Conn.	Apr. 26, 1900.
Samuel Webber	Hydraulic Engineer	Charlestown, N. H.	Apr. 28, 1897.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills, Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co. 120 Commercial St.,	Adams, Mass.	Apr. 29, 1896.
Stephen L. Adams	Treas. Stafford Mfg. Co.	Central Falls, R. I.	Apr. 24, 1895.
Joseph D. Aiken	Asst. Supt. Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co. Box 34,	Providence, R. I.	Apr. 28, 1886.
B. A. Alexander	Supt. Boston Duck Co.	Bondsville, Mass.	Apr. 28, 1898.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co., Box 83, 47 Charles St.,	Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co. 70 Kilby St.,	Boston, Mass.	Apr. 25, 1894.

Frederic Amory . . . Treas. Nashua Mfg. Co. and Jackson Mfg. Co. . . . . Room 51, Simmons B'l'd., 40 Water St., Boston, Mass. Apr. 27, 1899.

Thomas Armstrong . . Supt. No. Pownal Mfg. Co. . . . . No. Pownal, Vt. . . Oct. 27, 1897.

Abel T. Atherton . . . Machine Maker . . . . . Bay Side, R. I. . . . Oct. 16, 1872.

Edward Atkinson . . . Prest. Boston Mfrs. Mu. Fire Ins. Co. . . . . 31 Milk St., Boston, Mass. . . . Apr. 19, 1871.

E. W. Atkinson . . . . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . Oct. 27, 1886.

H. C. Atwood . . . . Treas. Williamsville Manufg. Co. . . Providence, R. I. . . Apr. 29, 1885.

James A. Atwood . . . Agt. Wauregan Mills and Quinebaug Co. . . . . Wauregan, Conn. . . Oct. 28, 1891.

John Walter Atwood . Supt. Wauregan Mills . . . . . Wauregan, Conn. . . Oct. 24, 1895.

W. E. Atwood . . . . Secy. and Asst. Treas. Williamsville Manufg. Co. . . . . Killingly, Conn. . . . Sept. 27, 1894.

George A. Ayer . . { Supt. City Mfg. Corp. / Supt. Bristol Mfg. Corp. } 123 Fifth St., New Bedford, Mass. Apr. 24, 1895.

Charles L. Bailey . . . . . Waltham, Mass. . . Sept. 27, 1894.

Henry A. Bailey . . . Agt. Chicopee Manufg. Co. . . . . Chicopee Falls, Mass. Oct. 25, 1893.

Edwin H. Baker . . . Bliss, Fabyan & Co., Box 2899 . . . . . 117 Duane St., New York City, N. Y. Apr. 24, 1878.

Edward R. Ballou . . . Treas. Ballou Yarn Converting Co., ... 189 Charles St., Providence, R. I. . . Apr. 25, 1894.

William P. Bancroft . . Vice-Pres. Joseph Bancroft & Sons Co. . . . . Wilmington, Del. . . Oct. 31, 1883.

Louis B. Barker . . . Agt. United States Cotton Co. . . . Central Falls, R. I. . Apr. 27, 1899.

Lewis E. Barnes . . . Agt. Pemberton Co. & Methuen Co., Methuen, Mass. . . . Oct. 24, 1895.

William A. Barrell . . Agt. Lawrence Duck Co. . . . . Lawrence, Mass. . . Apr. 30, 1884.

Thomas Barrett, Jr. . . Pres. Langley & Aiken Mills . . . Augusta, Ga. . . . . Apr. 26, 1900.

Edwin N. Bartlett . . . Supt. Sigourney and Rockdale Mills, North Oxford, Mass. . Apr. 29, 1891.

Daniel Moore Bates, Jr. Asst. Supt. Joseph Bancroft & Sons Co., Wilmington, Del. . . Apr. 28, 1898.

Joseph P. Battles . . . Treas. Lewiston Mach. Co. . . . . Lewiston, Me. . . . Oct. 24, 1895.

Edward C. Beach . . Agt. Mass. Mills in Georgia . . . . Lindale, Georgia . . Oct. 5, 1899.

George W. Bean . . . Agt. Androscoggin Mills . . . . . Lewiston, Me. . . . Apr. 17, 1872.

Robert Beatty . . . . Robert Beatty & Co. . . . . Coral and Adams Sts., Philadelphia, Pa. . . Oct. 27, 1897.

Truman Beckwith . . . Treas. Dyerville Manufg. Co. Box 171, Providence, R. I. . . Apr. 27, 1892.

John W. Bell . . . . . Asst. Treas. and Mgr. Smith & Dove Manufg. Co. . . . . Andover Mass. . . . Oct. 27, 1897.

A. C. Bent . . . . . Agt. Safety Seamless Pocket Co. . . Taunton, Mass. . . . Oct. 27, 1897.

W. N. Blackstone . . { Treas. Attawaugan Co. / Treas Totokett Mills Co. } . . . . Norwich, Conn. . . . Apr. 29, 1896.

William W. Blades . . Gen. Supt. Lorraine Mfg. Co. . . . . 135 Mineral Spring Ave., Pawtucket, R. I. . . Oct. 25, 1893.

T. Ashby Blythe . . . Proprietor Ashby Cotton Mills . . . . . 114 Chestnut St., Philadelphia, Pa. . . Oct. 27, 1897.

John P. Bodge . . . . Treas. Arkwright Mills . . . . . Fall River, Mass. . . Oct. 27, 1897.

Jefferson Borden, Jr.	Supt. Fall River Bleachery	Fall River, Mass.	Apr. 27, 1899.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. / Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 18, 1866.
Thomas J. Borden	Pres. Richard Borden Manufg. Co.	Box 118, Fall River, Mass.	Apr. 20, 1865.
E. S. Boss	Agt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
Stephen N. Bourne	Agt. Stark Mills	Manchester, N. H.	Oct. 21, 1869.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen Mills,	Riverpoint, R. I.	Oct. 24, 1895.
A. W. Brainerd		Box 33, Lawrence, Mass.	Apr. 28, 1898.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
Christopher P. Brooks	Managing Director New Bedford Textile School	New Bedford, Mass.	Apr. 28, 1897.
Henry R. Brown	Supt. Hope Co. and Phenix Mill, Box 56,	Phenix, R. I.	Apr. 28, 1897.
Isaac A. Brown	Treas. Narragansett Mills	Box 324, Fall River, Mass.	Sept. 29, 1898.
James W. Brown	P. O. Box 312,	Ipswich, Mass.	Oct. 24, 1895.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
Thomas J. Brown	George Brown's Sons	Mt. Joy, Penn.	Oct. 27, 1897.
E. C. Bucklin	Treas. Interlaken Mills, / Treas. Harris Mfg. Co.	Box 289, Providence, R. I.	Apr. 25, 1883.
Robert Burgess	Agt. Grinnell Mfg. Corp.	745 County St., New Bedford, Mass.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 28, 1880.
Alfred H. Burnham	Mgr. Glasgow Mills	Huntington and Jasper Sts., Philadelphia, Pa.	Apr. 26, 1900.
Hervey Burnham	Supt. Beaver Mills and Eclipse Mill	North Adams, Mass.	Apr. 27, 1899.
W. R. Burnham		Norwich, Conn.	Apr. 29, 1885.
William D. Cadwell	Agt. Nashua Mfg. Co. & Jackson Co.,	Nashua, N. H.	Apr. 19, 1871.
William H. Cadwell	Supt. Jackson Company	Nashua, N. H.	Apr. 26, 1900.
John P. Campbell	Supt. New York Mills,	New York Mills, Oneida Co., N. Y.,	Sept. 22, 1896.
Byron F. Card	Agt. Howland Mills	New Bedford, Mass.	Apr. 25, 1888.
George A. Chace	Treas. Bourne Mills	Fall River, Mass.	Apr. 25, 1877.
James C. Chalmers	Vice-Pres. Renfrew Mfg. Co.	Adams, Mass.	Oct. 5, 1899.
Simeon B. Chase	Treas. King Philip Mills	Fall River, Mass.	Apr. 21, 1875.
Clarence N. Childs	Asst. Supt. Hamilton Manufg. Co.	43 Pine St., Lowell, Mass.	Apr. 24, 1895.
Elmer G. Childs	Agt. Boston Duck Co.	Bondsville, Mass.	Oct. 26, 1892.
Jno. H. C. Church	Asst. Treas and Sec. Monument Mills,	Gt. Barrington, Mass.	Apr. 28, 1897.
Ernest E. Clark	Asst. Supt. H. N. Slater Mills	Webster, Mass.	Apr. 29, 1896.
George A. Clark	Supt. Manchester Mills	Manchester, N. H.	Oct. 25, 1882.
Alfred Clarke	Gen'l Mgr.	23 Central St., Boston, Mass.	Apr. 30, 1879.
E. N. Clemence	Sec. and Treas. Eagle & Phenix / Mills and Agt. for Receivers	Columbus, Ga.	Apr. 28, 1897.
W. H. Cloher, Jr.	Treas. Utica Cotton Co.	Capron, Oneida Co., N. Y.	Sept. 22, 1896.

Alonzo A. Coburn	Treas. Atherton Machine Co.	Lowell, Mass.	Apr. 25, 1888.
Josiah G. Coburn	99 Washington St.,	Newton, Mass.	Apr. 20, 1865.
Charles H. Collins	Supt. Berkeley Co.	Ashton, R. I.	Apr. 26, 1900.
John A. Collins	Supt. American Linen Co. 73 Cottage St.,	Fall River, Mass.	Oct. 31, 1883.
B. B. Comer	Pres. and Treas. Avondale Cotton Mills	Birmingham, Ala.	Apr. 26, 1900.
Frank B. Comins	Treas. American Moistening Co. 150 Devonshire St., Room 67,	Boston, Mass.	Oct. 28, 1891.
Caesar Cone	Pres. Proximity Mfg. Co.	Greensboro, N. C.	Apr. 26, 1900.
John J. Connell	Supt. Cohannet Mills	Taunton, Mass.	Apr. 27, 1892.
Augustus De Cort	Treas. Beacon Mfg. Co., P. O. Box 2815	Boston, Mass.	Apr. 26, 1900.
Frank H. Cotton	Supt. Hope Mills Mfg. Co.	Hope Mills, N. C.	Apr. 27, 1899.
Alphonse S. Covel	Treas. Tremont and Suffolk Mills, P. O. Box 1716, 70 Kilby St.,	Boston, Mass.	Oct. 31, 1877.
William W. Crapo	Pres. Wamsutta Mills	New Bedford, Mass.	Sept. 29, 1898.
P. T. Creed	Agt. Hopewell Mills	Box 356, Taunton, Mass.	Sept. 22, 1896.
John B. Cudlip	Supt. Gibson Cotton Mills	Marysville, N. Bruns.	Apr. 28, 1897.
H. H. Culver	Supt. Elizabeth Poole Mills 39 Ashland St.,	Taunton, Mass.	Apr. 28, 1897.
Henry S. Culver	Supt. Westville Cotton Mill	Taunton, Mass.	Apr. 28, 1897.
A. G. Cumnock	Treas. Appleton Co.	Lowell, Mass.	Oct. 28, 1885.
Andrew J. Currier	Mgr. Albion and Valley Falls Co.	Valley Falls, R. I.	Apr. 25, 1888.
T. B. Dallas	Treas. Phœnix Cotton Mills Treas. Dallas Manufg. Co.	Box 386, Nashville, Tenn.	Oct. 24, 1895.
Philip Dana	Supt. Dana Warp Mills	Westbrook, Me.	Sept. 29, 1898.
Woodbury K. Dana	Treas. Dana Warp Mills	Westbrook, Me.	Apr. 25, 1888.
Albert W. Danforth	Supt. & Engineer Shanghai Cot. Cloth Mills, Shanghai, China 881 Bridge St.,	Lowell, Mass.	Apr. 27, 1881.
A. Lockwood Danielson	Asst. Treas. Quinebaug Co., Box 900,	Providence, R. I.	Sept. 27, 1894.
J. DeForest Danielson	Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works	Providence, R. I.	Sept. 27, 1894.
John W. Danielson	Treas. Lockwood Co.	Box 900, Providence, R. I.	Jan. 15, 1868.
B. D. Davol	Pres. Barnard Mfg. Co.	P. O. Box 418, Fall River, Mass.	Apr. 25, 1877.
James C. Deane	Supt. Griswoldville Manufg. Co.	Griswoldville, Mass.	Apr. 25, 1894.
George DeForest	Treas. Utica Steam Cotton Mills	Utica, New York	Oct. 27, 1897.
William P. Dempsey	Treas. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Agt. Johnson Manufg. Co. Agt. Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny	Pres. American Card Clothing Co.	Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Pepperell Mfg. Co. 30 Kilby St.,	Boston, Mass.	Apr. 29, 1896.
Charles Owen Dexter	Mgr. Canadian Col'd Cotton Mills Co. Ltd.	Hamilton, Ont., Can.	Apr. 24, 1895.
Lewis Dexter, Jr.	Mgr. The Canadian Colored Cotton Mills Co., Ltd.	Milltown, N. B.	Apr. 27, 1899.

Samuel Dibble	Pres. Enterprise Cotton Mills,	Orangeburg, S. C.	Sept. 29, 1898.
John W. Dickinson	Supt. Lyman Mills	Holyoke, Mass.	Oct. 27, 1897.
F. Dilling	Pres. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 24, 1895.
Albert W. Dimick	Agt. Indian Head Mills of Alabama,	Cordova, Ala.	Apr. 25, 1894.
Bradford C. Divine	Supt. and Mgr. Utica Willow Vale Bleaching Co.	Chadwicks, N. Y.	Apr. 27, 1899.
Eben S. Draper	Agt. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Treas. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Sec'y Draper Co.	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Pres. Draper Co.	Hopedale, Mass.	July 17, 1867.
William F. Draper, Jr.	Draper Co.	Hopedale, Mass.	Oct. 29, 1890.
T. C. Duncan	Treas. Union Cotton Mills	Union, S. C.	Apr. 26, 1900.
Joseph M. Dunham	43 Edwards St.,	Springfield, Mass.	Oct. 26, 1892.
Frank H. Dwelly	Treas. Tecumseh Mills	Fall River, Mass.	Apr. 27, 1899.
David H. Dyer	D. H. Dyer & Son, Mill Engineers 6, 7 and 8 Pocassett Bank Building,	Fall River, Mass.	Oct. 18, 1871.
William A. Eastman	Treas. Lowell Hosiery Co.	Lowell, Mass.	Apr. 24, 1878.
Russell W. Eaton	Agt. Cabot Manufg. Co.	Brunswick, Me.	Oct. 26, 1887.
John Eccles	Supt. Ponemah Mills	Taftville, Conn.	Apr. 27, 1892.
Lawrence V. Elder	Man. Dir. Galveston City Cotton Mills 212 Tremont St.,	Galveston, Texas	Oct. 27, 1886.
Oscar Elsas	Vice-Pres. Fulton Bag & Cotton Mills, P. O. Box 773,	Atlanta, Ga.	Apr. 28, 1897.
Frederick W. Ely	Agt. Columbian Manufg. Co.	Greenville, N. H.	Apr. 25, 1888.
Charles Estes	Pres. John P. King Mfg. Co.	Augusta, Ga.	Apr. 26, 1900.
H. B. Estes	Agt. Continental Mills	Lewiston, Me.	Apr. 26, 1893.
William Evans	Supt. Richard Borden Mfg. Co.	Fall River, Mass.	Apr. 29, 1896.
Herbert R. Farnum	Supt. Bernon Mills	Georgiaville, R. I.	Apr. 27, 1881.
Charles F. Farrar	Supt. Groveville Mills	Yardville, N. J.	Oct. 27, 1897.
James T. Ferguson	Supt. Boott Mills	Lowell, Mass.	Oct. 5, 1899.
Frank S. Field	Supt. & Agt. Massaemit Yarn Mills	Shattuckville, Mass.	Oct. 24, 1895.
William Firth	Pres. American Moistening Co. P. O. Box 1460, 150 Devonshire St., Room 67,	Boston, Mass.	Apr. 25, 1888.
Charles H. Fish	Agt. Cocheco Manufg. Co.	Dover, N. H.	Apr. 27, 1887.
Henry E. Fisher	Vice-Pres. & Agt. Atlanta Cotton Mills	Atlanta, Ga.	Oct. 24, 1895.
Herbert Fisher		Taunton, Mass.	Oct. 29, 1879.
William B. Fittz	Supt.	Easthampton, Mass.	Oct. 26, 1892.
Frederick A. Flather	Mech. Engineer & Foreman Lowell Machine Shop	Lowell, Mass.	Apr. 29, 1891.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Philip H. Fowler		Gloucester City, N. J.	Nov. 30, 1881.
Edward W. France	Dir. of Philadelphia Textile School, N. W. Cor. Broad and Pine Sts.,	Philadelphia, Pa.	Sept. 22, 1896.

Arthur C. Freeman	Supt. Finishing Dept., Boston Mfg. Co. 97 Church St.	Waltham, Mass.	Apr. 27, 1899.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
W. T. Galey	Pres. Aberfoyle Manufg. Co.	Chester, Pa.	Apr. 28, 1897.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
James G. Garland	10 Adams St.	Biddeford, Me.	Oct. 29, 1879.
Edward T. Garsed	Treas. Hucomuga Mills	Greensboro, N. C.	Apr. 28, 1898.
Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford	Philadelphia, Pa.	Oct. 27, 1897.
James A. Gary	Alberton Mills. 108 W. German St.	Baltimore, Md.	Apr. 25, 1883.
James Gee	Supt. Interlaken Dye Works	Fiskville, R. I.	Apr. 28, 1898.
Charles E. Getchell	Supt. Waltham Bleachery and Dye Works P. O. Box 62, 35 Willow St.	Waltham, Mass.	Oct. 30, 1889.
Daniel Gilligan	Supt. Pocasset and Metacomet Mills,	Fall River, Mass.	Apr. 29, 1896.
William C. Godfrey	Agt. Indian Orchard Co.	Indian Orchard, Mass.	Oct. 29, 1890.
Alfred M. Goodale	Treas. Boston Manufg. Co. 50 State St.	Boston, Mass.	Apr. 25, 1883.
Louis B. Goodall	Treas. Goodall Worsted Co.	Sanford, Me.	Oct. 5, 1899.
Frederick B. Gordon	Pres. and Gen. Mgr. Columbus Mfg Co.	Columbus, Ga.	Apr. 26, 1900.
Charles H. Gorton	Supt. Columbus Mfg. Co.	Columbus, Ga.	Apr. 25, 1894.
Marcellus Gould	Pres. and Mgr. N. H. Spinning Co.	Penacook, N. H.	Sept. 22, 1896.
George P. Grant, Jr.	Treas. Grant Yarn Co.	Fitchburg, Mass.	Sept. 27, 1894.
D. W. Gray	Supt. Skenandoa Cotton Co.	Utica, N. Y.	Oct. 26, 1892.
R. A. Gray	Supt. Rodman Manufg. Co.	Allenton, R. I.	Apr. 24, 1895.
Stephen Greene	Mill Architect and Engineer 131 Devonshire St.	Boston, Mass.	Oct. 27, 1886.
William C. Greene	Treas. Peace Dale Manufg. Co.	Peace Dale, R. I.	Oct. 27, 1886.
Joseph Warren Greene	Supt. Hamilton Web Co.	Hamilton, R. I.	Apr. 29, 1896.
John T. Greenwood	R. Greenwood & Bault 4720 Leiper St., Frankford, Philadelphia, Pa.		Apr. 26, 1900.
S. Greenwood	Mgr. Canadian Col'd Cot. Mills Co.	Cornwall, Ontario	Oct. 5, 1899.
John Gregson	Agt. Fiskdale Mills	Fiskdale, Mass.	Apr. 24, 1895.
Maxwell Grierson	Gen. Mgr. Jas. Chadwick & Bro., Ltd.,	Jersey City, N. J.	Apr. 28, 1898.
Frederick Grinnell	Pres. Gen. Fire Extinguisher Co.	New Bedford, Mass.	Apr. 24, 1878.
David Grove	Supt. Dyerville Manufg. Co. 610 Manton Ave.,	Providence, R. I.	Apr. 28, 1898.
H. S. Grove	Pres. Argo Mills Co., 218 Race St.,	Philadelphia, Pa.	Apr. 28, 1898
Arthur H. Gulliver	Agt. Boston Mfg. Co.	Waltham, Mass.	Apr. 24, 1889
B. F. Guy	Gen. Supt. Pelzer Manufg. Co.	Pelzer, S. C.	Apr. 24, 1895
William J. Hadfield	225 Bailey St.,	Lawrence, Mass.	Apr. 27, 1899
Effingham C. Haight	Treas. Wampanoag Mills	Fall River, Mass.	Apr. 27, 1899
Frank J. Hale	Agt. Saco and Pettee Machine Shops Newton Upper Falls, Mass.		Apr. 27, 1892.

William E. Hall . . . Treas. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 27, 1892.
Z. D. Hall . . . . . Supt. Berkshire Cotton Mfg. Co. . . . . 70 Orchard St., P. O. Box 963, Adams, Mass. . . . Oct. 29, 1879.
John H. Hambly . . . Treas. Quidnick Manufg. Co. . . . . 49 Westminster St., Providence, R. I. . . Apr. 24, 1895.
A. M. Hamilton . . . Supt. Parker Mills . 362 Linden St., Fall River, Mass. . . Apr. 28, 1897.
John F. Hamlet . . . P. O. Box 160 . . . . . Fall River, Mass. . . Oct. 31, 1888.
Joseph O. Hannum . . Agt. Saratoga Victory Manufg. Co. . . . . Victory Mills, Saratoga Co., N. Y. . Apr. 30, 1890.
Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . Room 509, State Mutual Building, Worcester, Mass. . . Apr. 30, 1890.
John J. Hart . . . . . Pres. and Gen. Mgr. Charlton Manufg. Co. . . . . P. O. Box 94, Pawtucket, R. I. . . Apr. 24, 1895.
William D. Hartshorne Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 27, 1899.
Samuel E. Hathaway . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Sept. 27, 1894.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.
William B. Hawes . . Yarn Broker . . . . P. O. Box 733, Fall River, Mass. . . Oct. 24, 1895.
Alfred Hawkesworth . Supt. Merchants' Cotton Co. . . . . Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Asst. Supt. Merchants' Cotton Co. . Montreal, P. Q. . . . Sept. 22, 1896.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
W. G. Henderson . . . Agt. Shetucket Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
James G. Hill . . . . Cotton Manufr., Merrimack House . Lowell, Mass. . . . Jan. 15, 1868.
William R. Hill . . . Treas. Glasgow Manufg. Co. . . . . South Hadley Falls, Mass. Oct. 25, 1893.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co. . Fall River. Mass. . Oct. 24, 1895.
Charles H. Hobbs . . Agt. Thorndike Co. . . . . Thorndike, Mass. . . Apr. 28, 1886.
Franklin W. Hobbs . . Asst. Treas. Arlington Mills . . . . . P. O. Box 3590, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
Louis L. Hohn . . . . . 122 High St., Westerly, R. I. . . . Apr. 28, 1897.
John Holland . . . . 12 Trackey St. . . . P. O. Box 96, Dover, N. H. . . . . Oct. 31, 1877.
Charles M. Holmes . . Supt. Manchaug Co. . . . . Manchaug, Mass. . . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.
George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
William P. Holt . . . Agt. William A. Slater Mills Corp. . . . . Box 315, Slatersville, R. I. . . Oct. 25, 1893.
George L. Hooper . . Pres. and Gen. Mgr. Hooper Knitting Co. . . . . 7 Belmont St., Lowell, Mass. . . . . Apr. 27, 1892.
Thomas Horsfield . . . Overseer of Weaving, 95 Bonney St., New Bedford, Mass. . Oct. 27, 1897.
Henry S. Houghton, Jr. Supt. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 24, 1895.
W. C. Houston . . . . Pres. Hope Mills Manufg. Co. . . . . 333 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Elisha H. Howard . . Treas. Harris Textile Co. . . . . 309 Butler Exchange, Providence, R. I. . . Apr. 25, 1883.
Henry S. Howe . . . . Dry Goods Commission, 68 Chauncy St., Boston, Mass. . Oct. 31, 1877.
Albert C. Hoy . . . . Asst. Supt. Hamlet Mills . . . . . Woonsocket, R. I. . . Apr. 28, 1898.

W. S. Hume . . . . . Supt. Dominion Cotton Mills, Ltd. . . . . 176 Notre Dame St., Hochelaga, P. Q., Can. Oct. 29, 1890.
A. W. Hunking . . . . Agt. Merrimack Mfg. Co. . . . . Huntsville, Ala. . . Apr. 24, 1895.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 27, 1897.

J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Agt. N. E. Cotton Yarn Co. (Globe Dept.) . . . . . Fall River, Mass. . . Sept. 29, 1898.
David L. Jewell . . . Agt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 20, 1865.
David S. Johnston . . Treas. Cohoes Iron Foundry & Mach. Co., Cohoes, N. Y. . Oct. 28, 1891.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 24, 1895.

Frank E. Kaley . . . . Treas. Morse & Kaley Mfg. Co. . . Milford, N. H. . . . Oct. 24, 1895.
W. E. Keach . . . . . Supt. Grant Yarn Co. . 123 Myrtle Ave., Fitchburg, Mass. Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
George E. Kent . . . . Treas. Exeter Manufg. Co. . . . . Pittsfield, N. H. . . Oct. 31, 1888.
Hervey Kent . . . . . Pres. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Apr. 20, 1865.
Nathaniel B. Kerr . . . Agt. Boott Cotton Mills . . . . . Lowell, Mass. . . . Oct. 26, 1892.
John Kilburn . . . . . Belmont, Mass. . . . Apr. 20, 1865.
Harry W. Kimball . . Supt. Dominion Cotton Mills Co. . . . . Magog, Province Quebec, Can. . . . . Oct. 24, 1895.
Benjamin B. Kirk . . . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Apr. 28, 1897.
Albert Knight . . . . Supt. Quidnick Mills . . . . . Quidnick, R. I. . . . Apr. 24, 1895.
Albert F. Knight . . . . . 39 Main St., Woonsocket, R. I. . . Oct. 27, 1886.
C. Prescott Knight . . Pres. River Point Corp. . . . . River Point, R. I. . . Sept. 29, 1898.
Jesse A. Knight . . . . Sec'y & Supt. Lawton Spinning Co. Providence, R. I. . . Oct. 26, 1892.
Stephen A. Knight . . Pres. and Agt. Hebron Manufg. Co. . . . . Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . Reynolds Manufg. Co. . . . . Davisville, R. I. . . Apr. 24, 1889.
Webster Knight . . . Pres. Natick Mills 3 Washington Row, Providence, R. I. . . Sept. 29, 1898.

Fred Lacey . . . . . Gen. Mgr. Montreal Cotton Co. . . Valleyfield, P. Q. . . Apr. 24, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw . Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.
Elliott Cowdin Lambert Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 24, 1895.
George H. Law . . . Supt. Merchants' Mfg. Co. . . . . 815 Walnut St., Fall River, Mass. . . Apr. 28, 1897.
Abbott F. Lawrence . . Treas. Winthrop Cotton Yarn Co . . . . . Box 848, Taunton, Mass. . . . Apr. 24, 1895.
Harold Lawton . . . . Gen. Mgr. Warwick Mills . . . . . Centreville, R. I. . . Oct. 27, 1886.
Evan Arthur Leigh . . Textile Machinery . . 70 Kilby St., Boston, Mass. . . . Oct. 29, 1890.
John Leiper . . . . . Supt. Fitchburg Worsted Mills . . . . . 171 Blossom St., Fitchburg, Mass. . . Oct. 27, 1897.

J. Colby Lewis	Supt. W. A. Slater Mills Corp.	Jewett City, Ct.	Oct. 26, 1892.
Leontine Lincoln	Pres. Seaconnet Mills	Fall River, Mass.	Apr. 28, 1897.
B. F. G. Linnell	Greene & Daniels Mfg. Co.	Pawtucket, R. I.	Oct. 27, 1897.
Charles Warren Lippitt	Treas. Silver Spring B. & D. Co.	Providence, R. I.	Oct. 30, 1878.
Henry F. Lippitt	Agt. Social and Manville Cos.	Providence, R. I.	Apr. 27, 1881
William H. Loftus	Supt. Clark Thread Co.	Newark, N. J.	Oct. 27, 1897.
Robert W. Lord	Agt. R. W. Lord & Co.	Kennebunk, Me.	Oct. 20, 1869.
Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Agt. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William C. Lovering	Pres. Whittenton Mfg. Co.,	40 Water St., Boston, Mass.	Oct. 25, 1876.
William M. Lovering	Supt. Whittenton Manufg. Co.	Taunton, Mass.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Manufg. Co.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Asst. Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
Dudley T. Lyall	Asst. Mgr. Brighton Mills	541 W. 23d St., N. Y.	Sept. 22, 1896.
William L. Lyall	Supt. J. & W. Lyall Loom and Machine Works	540 W. 23d St., New York City	Oct. 26, 1892.
Herbert Lyman		Box 1717, Boston, Mass.	Oct. 24, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 24, 1895.
Alvin S. Lyon	Supt. Lowell Manufg. Co.	Lowell, Mass.	Apr. 26, 1882.

James R. MacColl	Treas. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895
Charles L. Macomber	Pres. Winthrop Cotton Yarn Co.	Taunton, Mass.	Apr. 24, 1895.
Charles T. Main	Mech. and Mill Engineer Dean & Main	53 State St., 1112 Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
A. T. Malcolmson	Agt. C. Bischoff & Co.	Box 1104, Providence, R. I.	Oct. 27, 1897.
Arthur B. Mann	J. H. Martin & Co., Box 465,	99 Franklin St., New York	Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 27, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 182, Griffin, Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin		Shirley, Mass.	Apr. 28, 1897.
John R. Mason		237 Main St., Cohoes, N. Y.	Apr. 28, 1897.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAuliffe	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 28, 1898.
Charles D. McDuffie	Agt. Manchester Mills	Manchester, N. H.	Apr. 21, 1869.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2934, 40 Water St., Boston, Mass.	Oct. 25, 1882.
William G. McLoon	Supt. Lancaster Mills,	Clinton, Mass.	Apr. 27, 1892.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Gen. Supt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.

Henry P. Meikleham, . Supt. Aiken Mfg. Co. . . . . Bath, S. C. . . . . Apr. 26, 1900.
Charles H. Merriman, Jr. Supt. Social Mgr. Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895.
Frank M. Messenger . Agt. Grosvenor Dale Co. . . . No. Grosvenor Dale, Conn. Apr. 27, 1887.
W. H. Miles . . . . . Agt. Farwell Mills . . . . . Lisbon, Me. . . . . Sept. 22, 1896.
R. M. Miller, Jr. . . . Vice-Pres. and Sec. The Atherton Mills Charlotte, N. C. . . . Sept. 29, 1898.
James I. Milliken . . . Agt. Everett Mills . . . . . Lawrence, Mass. . . Oct. 26, 1892.
Roscoe S. Milliken . . Supt. Nashua Mfg. Co. . . . . Nashua, N. H. . . . Apr. 29, 1896.
David Milne . . . . . C. J. Milne & Sons . . . . . Washington Ave. & 11th St., Philadelphia, Pa. . . Apr. 28, 1897.
A. B. Mole . . . . . Mgr. Greylock Mill . . . . . Adams, Mass. . . . Apr. 24, 1895.
Edward A. Mongeon . Supt. Lonesdale Cos. Mills . . . . Lonesdale, R. I. . . Apr. 24, 1895.
J. R. Montgomery . . Pres. The J. R. Montgomery Co. . . Windsor Locks, Conn. Sept. 29, 1898.
George A. Moody . . Supt. Warren Cotton Mills . . . . West Warren, Mass. . Apr. 27, 1899.
James Sumter Moore . Sec. and Treas. Olympia & Richland Cotton Mills . . . . Columbia, S. C. . . . Apr. 26, 1900.
Fred W. Moore . . . Agt. Cordis Mills . . . . . Millbury, Mass. . . . Apr. 27, 1892.
Albert H. Morton . . . Supt. Kitson Machine Co. . . . . Lowell, Mass. . . . Oct. 28, 1891.
Oliver H. Moulton . . Supt. Hamilton Manufg. Co. . . . Lowell, Mass. . . . Apr. 20, 1865.
Farquharson J. Muir . Supt. Canadian Col'd Cot. Mills Co., Ltd., St. Croix Mill . . Milltown, N. B., Can. Apr. 27, 1892.

Roscius C. Newell . . . Supt. Palmer Mill . . . . . Three Rivers, Mass. . Oct. 24, 1895.
William G. Nichols . . Sec. and Treas. Springstein Mills . Chester, S. C. . . . . Oct. 25, 1893.
William M. Nixon . . . Pres. Atlanta Woolen Mills . . . . Atlanta, Ga. . . . . Oct. 5, 1899.
Franklin Nourse . . . Agt. Lawrence Manufg. Co. . . . . Lowell, Mass. . . . Apr. 24, 1878.

S. Odenheimer . . . . Treas. Lane Mills . . . . . New Orleans, La. . . Oct. 25, 1893.
Charles K. Oliver . . . Treas. Mt. Vernoon-Woodberry Cotton Duck Co. . . . . 346-8 Equitable Bld., Baltimore, Md. . . . Sept. 27, 1894.
J. Edward Osborn . . . Treas. American Linen Co. . . . . Fall River, Mass. . . Apr. 28, 1897.
Herbert W. Owen . . Asst. Supt. Merchants' Mfg. Co. . Fall River, Mass. . . Oct. 5, 1899.
Oscar L. Owen . . . . Mech. and Mill Eng. Whitin Machine Works . . . . . Whitinsville, Mass. . Apr. 25, 1894.

Elmer E. Page . . . . Agt. York Manufg. Co. . . . . Saco, Me. . . . . Apr. 27, 1892.
Francis J. Parker . . . Treas. Monadnock Mills, 81 Milk St., Boston, Mass. . . . Jan. 15, 1868.
O. B. Parker . . . . . Supt. U. S. Cotton Co. 218 Central St., Central Falls, R. I. . Apr. 24, 1895.
Samuel L. Parker . . . Supt. Turners Falls Cotton Mills . . . . . Box 627, Turners Falls, Mass. . Apr. 29, 1896.
Walter E. Parker . . . Agt. Pacific Mills, 217 Haverhill St., Lawrence, Mass. . . Apr. 25, 1877.
John H. Parks . . . . Pres. Wm. Parks & Son, Ltd. . . . St. John, N. B. . . . Apr. 24, 1878.
Duncan D. Parmly . . Treas. Johnson Mfg. Co. and Dunbar . . . . . Mills Co. . . . . 49 Wall St., New York, N. Y. . . Sept. 22, 1896.
John W. Pead . . . . Agt. Merrimack Manufg. Co. . . . . Box 1231, Lowell, Mass. . . . . Apr. 26, 1893.

James R. Pearce	Supt. Fulton Bag and Cotton Mills	Atlanta, Ga.	Oct. 24, 1895.
William C. Peirce	Pres. Elizabeth Mills, 564 Eddy St.,	Providence, R. I.	Apr. 24, 1895.
William D. Pennell	Agt. Hill Manufg. Co.	Lewiston, Me.	Apr. 16, 1873.
Haven C. Perham	Treas. Kitson Machine Co.	Lowell, Mass.	Apr. 30, 1879.
Henry C. Phillips	Supt. Atlantic Cotton Mills	Lawrence, Mass.	Apr. 25, 1894.
Benjamin Phipps	Treas. Clarendon Mills . 4 Winthrop Sq.	Boston, Mass.	Sept. 29, 1898.
Albert R. Pierce	Supt. Pierce Mfg. Corp.	New Bedford, Mass.	Oct. 5, 1899.
Andrew G. Pierce, Jr.	Treas. Rotch Spinning Co. Treas. Pierce Manufg. Corp. Treas. Howland Mills Corp.	P. O. Box, 34, New Bedford, Mass.	Apr. 24, 1895.
Reuben Pilling, Jr.	Supt. Granite Mills Co. 30 Hudson St.,	Providence, R. I.	Apr. 29, 1896.
Charles H. Plummer	Agt. Great Falls Manufg. Co.	Somersworth, N. H.	Apr. 25, 1888.
Charles T. Plunkett	Sec. Berkshire Cotton Mfg. Co.	Adams, Mass.	Apr. 28, 1897.
Joseph H. Potter, Jr.	Supt. Durfee Mills	Fall River, Mass.	Apr. 27, 1899.
J. F. Powers	Supt. Eagle Mill	North Adams, Mass.	Oct. 5, 1899.
Herbert L. Pratt	Agt. Bates Manufg. Co.	Lewiston, Me.	Oct. 27, 1875.
T. W. Pratt	Pres. West Huntsville Cotton Mill Co.	Huntsville, Ala.	Sept. 22, 1896.
John E. Prest	Gen. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 17, 1872.
M. W. Quinn	Agt. Hamilton Woolen Co.	Amesbury, Mass.	Oct. 27, 1886.
T. G. Ramsdell	Agt. Monument Mills	Housatonic, Mass.	Oct. 30, 1878.
Emory S. Rathbun	Supt. Pequot Mills	Montville, Conn.	Apr. 27, 1899.
M. A. Rawlinson	Supt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 24, 1895.
John F. Reardon	Agt. Falls Co.	Norwich, Conn.	Apr. 26, 1900.
Robert Redford	Mfr.	Lawrence, Mass.	Apr. 26, 1882.
R. S. Reinhardt	Treas. and Mgr. Elm Grove Cotton Mills	Lincolnton, N. C.	Apr. 28, 1898.
James Renfrew	Treas. Renfrew Manufg. Co.	Adams, Mass.	Oct. 18, 1871.
L. B. Renfrew	Asst. Mgr. Renfrew Mfg. Co.	Adams, Mass.	Oct. 5, 1899.
Frederick W. Reynolds	Supt. Potomska Mills	Box 299, New Bedford, Mass.	Apr. 26, 1900.
Roscoe C. Reynolds	Agt. and Treas. Lewiston Machine Co.	Lewiston, Me.	Oct. 25, 1876.
F. H. Rice	394 Pleasant St.,	Worcester, Mass.	Apr. 28, 1880.
Charles H. Richardson	Agt. Lancaster Mills	Clinton, Mass.	Apr. 24, 1889.
W. H. Richmond	Supt. Bibb Mill No. 2	Macon, Ga.	Oct. 27, 1897.
Walter Rigby	Supt. Ballou Yarn Converting Co. 189 Charles St.,	Providence, R. I.	Apr. 26, 1900.
Charles E. Riley	Textile Machinery	Box 2815 281 Congress St., Boston, Mass.	Apr. 25, 1888.
William H. Ritter	Gen. Supt. Johnson & Johnson	New Brunswick, N. J.	Apr. 26, 1900.
George W. Robbins	Supt. White Valley Mills	Smithville, Barre, Mass.	Apr. 28, 1897.
Benj. H. Roberts	General Mill Supplies 163 Grove St.,	Fall River, Mass.	Apr. 26, 1900.
Charles D. Robinson	Supt. Crompton Co.	Crompton, R. I.	Sept. 27, 1894.
William A. Robinson	Asst. Supt. Social Manufg. Co.	Woonsocket, R. I.	Apr. 29, 1896.
John R. Rostron	Overseer of Carding, Lancaster Mills,	Clinton, Mass.	Sept. 29, 1898.
John K. Russell	Gen. Mgr. May's Landing Water P. Co. and Millville Manufg. Co.	Millville, N. J.	Apr. 29, 1891.

Arnold B. Sanford	Pres. and Mgr. American Cotton Yarn Exchange	67 Chauncy St., Boston, Mass.	Oct. 25, 1882.
Charles Henry Savage	Supt. Manville Co.	Manville, R. I.	Apr. 26, 1893.
J. Herbert Sawyer		Chestnut Hill, Boston, Mass.	July 19, 1865.
F. C. Sayles	Pres. Ponemah and Baltic Mills	Pawtucket, R. I.	Oct. 27, 1897.
George H. Sayward	Mgr. Standard Yarn Co.	Oswego, N. Y.	Oct. 29, 1890.
Arnold Schaer	Supt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
Charles M. Sears	West Point Mfg. Co.	Langdale, Ala.	Apr. 28, 1898.
George H. Shapley	Treas. Silver Lake Co., 78 Chauncy St., Boston, Mass.		Apr. 29, 1896.
Frank P. Sheldon	Mill Engineer, Industrial Trust Bldg.	Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills	Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co.	Canton, Mass.	Apr. 29, 1896.
William F. Sherman	Mill Engineer	107 New Brazer Bldg., 27 State St., Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
Herbert H. Shumway	Treas. and Agt. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
N. G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 28, 1898.
Louis Simpson		Valleyfield, P. Q.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mill	Fall River, Mass.	Oct. 25, 1893.
Arba C. Slater	Supt. Linwood Mill	Linwood, Mass.	Jan. 15, 1868.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 24, 1895.
Joel Smith	Supt. The J. P. King Manufg. Co.	Augusta, Ga.	Oct. 24, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 27, 1897.
James Herbert Smith	Supt. Quinebaug Mills	Danielson, Conn.	Apr. 28, 1898.
Robert R. Smith	Mgr. Greenwoods Co.	New Hartford, Conn.	Oct. 19, 1870.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 26, 1900.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
S. S. Spencer	Supt. Conestogo Steam Mills	Lancaster, Pa.	Oct. 25, 1876.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 28, 1898.
George E. Spofford	Supt. Blackstone Mfg. Co.	Blackstone, Mass.	Apr. 29, 1896.
Henry B. Sprague	Treas. Boston Woven Hose and Rubber Co.	Cambridgeport, Mass.	Oct. 5, 1899.
Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 24, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
T. B. Stevenson	Supt. Readville Mill	Hyde Park, Mass.	Apr. 26, 1900.
Robert Stewart	Supt. Shove Mills	Fall River, Mass.	Apr. 27, 1899.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 24, 1895.
O. W. Stites	Gen. Mgr. Commonwealth Cotton Mfg. Co.	Durham, N. C.	Oct. 24, 1895.
Herman F. Straw	Agt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
John Sullivan	Supt. Union Cotton Mfg. Co.	Fall River, Mass.	Apr. 27, 1899.
Timothy Sullivan	Supt. Davol Mills	Fall River, Mass.	Apr. 27, 1899.
Walter H. Summersby	Supt. Pontiac Mill and Bleachery	Pontiac, R. I.	Oct. 25, 1893.
James O. Sweet	Agt. and Treas. Ashland Cotton Co.	Jewett City, Conn.	Apr. 28, 1886.

Robert Rennie Taft . . . . . P. O. Box 1443, Providence, R. I. . . Apr. 24, 1895.
Robert W. Taft . . . . Treas. Coventry Co. . . Box 1144, Providence, R. I. . . Sept. 27, 1894.
George P. Taylor . . . Treas. Danielsonville Cotton Co. of Danielson, Conn. . . .
. . . . . Clinton, Mass. . . . Oct. 27, 1880.
James W. Taylor . . . Supt. Canoe River Mills . Box 46, Taunton, Mass. . . . Oct. 26, 1892.
W. Marshall Taylor . . Supt. Merrick Thread Co. . . . . .
. . . . . 6 Arlington St., Holyoke, Mass. . . . Sept. 22, 1896.
Richard Thackeray . . Supt. Weetamoe Mills . . . . . Fall River, Mass. . . Apr. 29, 1885.
Earl A. Thissell . . . . Gen. Mgr. Woonsocket Bobbin Co. Woonsocket, R. I. . . Oct. 30, 1878.
Ariel C. Thomas . . . Supt. Clinton Manufg. Co. . . . . .
. . . . . 93 Clinton St., Woonsocket, R. I . . Oct. 31, 1888.
Charles E. Thomas . . Treas. Forestdale Manufg. Co. . . . . .
. . . . . 44 Prospect St., Woonsocket, R. I. . . Oct. 31, 1883.
Edward W. Thomas . . Agt. Tremont and Suffolk Mills . . . . . .
. . . . . 166 Pawtucket St., Lowell, Mass. . . . Apr. 30, 1884.
Ralph E. Thomson . . Supt. Parkhill Manufg. Co., Mill C. Fitchburg, Mass. . . Apr. 25, 1894.
D. M. Thompson . . . Supt. B. B. and R. Knight's Mills . . . . . .
. . . . . Box 1442, Providence, R. I. . . Oct. 28, 1885.
Joseph S. Tidd . . . . Treas. and Agt. Oakland Mills . . . Taunton, Mass. . . . Apr. 27, 1899.
Horace W. Tinkham . Treas. and Agt. Robeson Mills . . . Fall River, Mass. . . Apr. 27, 1899.
James P. Tolman . . . Pres. Samson Cordage Works . . . . . .
. . . . . 115 Congress St., Boston, Mass. . . . Oct. 29, 1890.
D. A. Tompkins . . . Engineer and Contractor The D. A. Tompkins Co. . . .
. . . . . Charlotte, N. C. . . . Oct. 24, 1895.
George W. Towne . . . Supt. Cotton Dept. Arlington Mills . Lawrence, Mass. . . Oct. 26, 1892.
Robert B. Treat . . . . Centerville Cotton Mills . . . . . Centerville, R. I. . . Sept. 27, 1894.
C. H. Truesdell . . . . Supt. Attawaugan Co. . . . . Dayville, Conn. . . . Oct. 29, 1884.
Edmund E. Truesdell . Supt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 26, 1876.
Oscar B. Truesdell . . . . . 18 Washington Terrace, Newtonville, Mass. . Oct. 15, 1873.
George F. Tryon . . . Supt. Conanicut Mills, 199 Purchase St., Fall River, Mass. . Apr. 28, 1897.
George E. Tucker . . . Agt. Otis Co. . . . . Ware, Mass. . . . . Oct. 24, 1895.
Charles D. Turnbull . . Treas. Wm. A. Slater Mills Corp. . . . . .
. . . . . The Ludlow, Boston Mass. . . . . Oct. 27, 1897.
George W. Turner . . Supt. Argo Mills . . . . . Gloucester, N. J. . . . Apr. 26, 1900.
William D. Twiss . . . Supt. Everett Mills . . . . . Lawrence, Mass. . . April 29, 1896.

Charles T. Upton . . . Supt. Shaw Stocking Co. . . . . .
. . . . . 63 Mt. Vernon St., Lowell, Mass. . . . Apr. 28, 1897.

George A. Vaughan . . Supt. The Putnam Manufg. Co. . . Putnam, Conn. . . . Sept. 22, 1896.
William P. Vaughan . Agt. Putnam Manufacturing Co. . . . . .
. . . . . Banigan Building, Providence, R. I. . . Sept. 29, 1898.
Eugene F. Verdery . . Pres. Warren Mfg. Co. . . . . Augusta, Ga. . . . . Apr. 26, 1900.
James P. Verdery . . . Pres. Enterprise Mfg. Co. . . . . Augusta, Ga. . . . . Apr. 26, 1900.
Frank P. Vogl . . . . Agt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 27, 1894.

Jude C. Wadleigh	Supt. Mass. Cotton Mills	Lowell, Mass.	Oct. 26, 1892.
Herbert E. Walmsley	Agt. Wamsutta Mills	New Bedford, Mass.	Oct. 29, 1890.
Robinson Walmsley	Supt. Tecumseh Mills	Fall River, Mass.	Apr. 27, 1899.
Frederick T. Walsh	Agt. Lowell Bleachery & Dye Works,	Lowell, Mass.	Apr. 28, 1897.
James A. Walsh	Agt. Lewiston Bleachery and Dye Works	Lewiston, Me.	Apr. 27, 1892.
John Waterman	Treas. Warren Manufg. Co.	Warren, R. I.	Apr. 30, 1884.
Joseph Watters	Supt. Osborn Mills	Fall River, Mass.	Apr. 26, 1900.
F. E. Wattles	Agt. Boscawen Mills	Penacook, N. H.	Oct. 5, 1899.
Joseph W. Wattles	Manufacturers' Supplies	Canton Junction, Mass.	July 18, 1866.
George W. Weeks		Clinton, Mass.	Apr. 21, 1869.
W. B. Smith Whaley	Mechanical & Mill Engineer Pres. Richland Cotton Mills Granby Cotton Mills,	1328 Main St., Columbia, S. C.	Apr. 24, 1895.
H. D. Wheat	Pres. and Treas. Gaffney Mfg. Co.	Gaffney, S. C.	Apr. 24, 1895.
Channing Whitaker	Infringement and Patentability of Inventions		
	Lowell Machine Shop	Lowell, Mass.	Oct. 15, 1873.
A. Tenny White	Supt. Manville Co.	Manville, R. I.	Oct. 26, 1887.
Charles D. White	Agt. Uncasville Mfg. Co.	Uncasville, Conn.	Oct. 27, 1897.
Z. L. White	White Brothers	Winchendon, Mass.	Apr. 28, 1897.
Arthur F. Whitin	Pres. Saunders Cotton Mills	Whitinsville, Mass.	Apr. 24, 1895.
Fred B. Whitin	Agt. Uxbridge Cotton Mills	Linwood, Mass.	Apr. 28, 1897.
Henry T. Whitin	Treas Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 25, 1877.
Alfred N. Whiting	Sec. and Treas. L. M. Harris Manufg. Co.	Oakdale, Mass.	Apr. 21, 1875.
William S. Whitney	Supervising Engineer, American Woolen Co.	Lawrence, Mass.	Apr. 24, 1878.
Arthur Whittam	Editor Textile Excelsior	Charlotte, N. C.	Apr. 28, 1898.
William Whittam, Jr.	Mgr. Lawton Spinning Co.	Woonsocket, R. I.	Apr. 26, 1893.
George F. Whitten	Agt. Amory Mfg. Co.	Manchester, N. H.	Oct. 26, 1892.
John H. Whitten	Supt. Stark Mills	Manchester, N. H.	Apr. 28, 1898.
Edward B. Wilbur	Supt. Gaffney Mfg. Co.	Gaffney, S. C.	Oct. 30, 1889.
Benjamin Wilcox	Treas. City and Bristol Mfg. Co.	New Bedford, Mass.	Apr. 26, 1900.
Henry M. Wilcox	Treas. John Rhodes Warp Co.	Millbury, Mass.	Apr. 24, 1889.
John B. Wild	Pres. Oneita Knitting Mills	Utica, N. Y.	Apr. 26, 1900.
Eben C. Willey	Agt. Atlantic Cotton Mills	Lawrence, Mass.	Apr. 29, 1896.
Theop. W. Wilmarth	Inspecting Engineer Amn. Steel & Wire Co.,	Worcester, Mass.,	Oct. 31, 1883.
Thomas Wilmarth	Supt. Saunders Cotton Mills	Saundersville, Mass.	Apr. 21, 1875.
J. P. Wilson	Treas. Dover Yarn Mills	Charlotte, N. C.	Oct. 24, 1895.
George Wood	Pres. and Treas. Millville Manufg. Co.		
	626 Chestnut St.,	Phila., Pa.	Oct. 16, 1872.
John P. Wood	Spring Garden and 22d St.,	Philadelphia, Pa.	Apr. 28, 1897.
C. J. H. Woodbury	Secretary and Treasurer	Lynn, Mass.	Oct. 29, 1879.
Adelbert R. Young	Supt. Ashland Cotton Co.	Jewett City, Conn.	Apr. 25, 1894.
James M. Young	Mgr. Hamilton Cotton Co.	Hamilton, Ont., Can.	Apr. 27, 1899.

ASSOCIATE MEMBERS.

H. B. Ashton . . . . Agt. S. A. Felton & Son Co. . . . . 153 Adams St., Medford, Mass. . . . Apr. 26, 1900.

Henry Ashworth . . . Agt. of Elijah Ashworth, Mfr. of Card Clothing . . . . . Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Pres. and Gen. Mgr. American Oil Co. . . . . 182 So. Water St., Providence, R. I. . . Apr. 24, 1895.

D. C. Ball . . . . . Gen. Mgr. The American Cotton Co. . . . . 27 William St., New York, N. Y. . . Oct. 24, 1895.

Edwin Barnes . . . . Hetherington & Sons, Textile Machinery . . . . . Apr. 26, 1900.
. . . . . Equitable Bld., Boston, Mass. . . . . Apr. 26, 1900.

George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.

Colin C. Bell . . . . Pres. and Treas. Laminar Fibre Co. No. Cambridge, Mass. Apr. 29, 1896.

Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.

William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.

F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 226 Devonshire St., Boston, Mass. . . . . Apr. 26, 1900.

J. Payson Bradley . . . The Kehew-Bradley Co. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.

J. Frank Braids . . Mgr. Grease & Oil Dept., Charles S. Bush Co. . . . . 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.

Henry G. Brinckerhoff . N. E. Mgr. Green Fuel Economizer Co., Box 2654 . . . . Room 1053, Exchange Bldg., 53 State St., Boston, Mass. Sept. 22, 1896.

D. Russell Brown . . . Pres. Brown Bros. Co. . . . . Providence, R. I. . . Apr. 24, 1895.

H. Martin Brown . . . Brown Bros. Co. . . . . Providence, R. I. . . Apr. 24, 1895.

Percy H. Brundage . . American Industrials Co. . . . . 290 Broadway, New York . . . . . Oct. 5, 1899.

John H. Burghardt . . Page Belting Co. . . . 31 Pearl St., Boston, Mass. . . . Apr. 24, 1895.

Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . Oct. 24, 1895.

Fred N. Bushnell . . . Mech. Supt. Narragansett Electric Light Co. . . . . 3 South St., Providence, R. I. . . Sept. 29, 1898.

Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Oct. 27, 1897.

James Butterworth . Pres. H. W. Butterworth & Sons Co. . . . . York and Cedar Sts., Philadelphia, Pa. . . Apr. 24, 1895.

Albert L. Calder, 2nd . Cotton Broker . . . . . Box 206, Providence, R. I. . . Apr. 26, 1900.

French Campbell . . . Commission Merchant, 75 Granite St., Manchester, N. H. . Oct. 27, 1897.

Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895.

W. W. Carey . . . . . Machinery and Pulley Manufacturer, Lowell, Mass. . . . . Apr. 24, 1895.

J. E. Cheesman . . . . Gen. Mgr. Cheesman Cotton Gin Co. . . . . 27 William St., New York . . . . . Oct. 5, 1899.

Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . P. O. Box 1406, 77 Exchange Place, Providence, R. I. . . . Apr. 24, 1895.

Henry C. Clark . . . . Asst. Treas. Standard Mill Supply Co. . . . . Box 714, Providence, R. I. . . . Apr. 28, 1898.

Peter H. Corr . . . . Cotton and Cotton Yarns and Waste . . . . . 38 Court St., Taunton, Mass. . . . . Apr. 24, 1895.

C. C. Cowan . . . . . Pres. Memphis Cotton Exchange . . . . . 316 Front St., Memphis, Tenn. . . . Oct. 5, 1899.

Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . Box 316, . Taunton, Mass. . . . . Apr. 24, 1895.

George Crompton . . . Treas. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . . Oct. 27, 1897.

Randolph Crompton . { Vice-Pres. and Asst. Supt. Crompton & Knowles Loom Works . . } Worcester, Mass. . . . Oct. 27, 1897.

C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.

Joseph L. Cushing . . Mfr. of Cotton Conveying Systems . Lowell, Mass. . . . . Apr. 26, 1900.

Frederick I. Dana . . . Manager. Thomas Phillips Co. . . . . Providence, R. I. . . . Apr. 24, 1895.

R. H. Deming . . . . Cotton Broker . 10 So. Water St., Providence, R. I. . . . Apr. 24, 1895.

C. E. W. Dow . . . . Agt. American Moistening Co. . . . . 40 So. Forsyth St., Box 410, Atlanta, Ga. . . . . Apr. 24, 1895.

Frederick A. Downes . Sec. Factory Mutual Fire Insurance Cos. . . . . 925 Chestnut St., Philadelphia, Pa. . . . Oct. 27, 1897.

G. B. Emmons . . . . Pres. Emmons Loom Harness Co. . . . . May St., Lawrence, Mass. . . . Oct. 24, 1895.

T. C. Entwistle . . . . Cotton Machinery Builder . . . . . Cor. Market and Northern Sts., Lowell, Mass. . . . . Apr. 24, 1895.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.

John W. Ferguson . . . . . 253 Broadway, Postal Telegraph Bldg., N. Y., and Paterson, N. J. . . . Apr. 24, 1895.

Redington Fiske . . . Gen. Mgr. Planters Compress Co. . . . . Room 60, 89 State St., Boston, Mass. . . . Apr. 27, 1899.

J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . . Apr. 24, 1895.

Merrill A. Furbush . . Pres. M. A. Furbush & Son Machine Co. . . . . 428-430 Philadelphia Bourse, Philadelphia, Pa. . . Oct. 27, 1897.

John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . . Apr. 28, 1897.

H. P. Garland . . . . Treas. Loom Picker Co. . . . . Biddeford, Me. . . . Oct. 24, 1895.

Royal W. Gates . . . . Josiah Gates & Sons, Belting . . . . . 307 Market St., Lowell, Mass. . . . Apr. 24, 1895.

Rufus B. Goff . . . . Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . . Apr. 28, 1897.
Sumner S. Gould . . . Mgr. Lowell Branch American Card Clothing Co. . . . . Lowell, Mass. . . . Oct. 5, 1899.
William S. Granger . . Prest. Granger Foundry & Machine Co., Providence, R. I. . Apr. 24, 1895.
Henry T. Grant, Jr. . . Pres. Mercantile Mutual Fire Ins. Co. . . . . Box 1153, 723 Banigan Building, Providence, R. I. . . . Oct. 27, 1897.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . 326 So. Water St., Providence, R. I. . . . Oct. 24, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . Box 409, Fall River, Mass. . . . Oct. 27, 1897.
Jerome Hill . . . . . Pres. Tennessee Planters' Co. . . . . 334 Front St., Memphis, Tenn. . . . . Apr. 29, 1896.
Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.
John Hogg . . . . . Smith, Hogg & Gardiner, 140 Essex St., Boston, Mass. . . . Apr. 27, 1899.
Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 24, 1895.
Henry S. Houghton, Sr., Mfr. Grids and Beaters . . . . . 61 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.
W. L. Hutchins . . . Asst. Mgr. Crompton & Knowles Loom Works . . . . . Providence, R. I. . . . Apr. 28, 1898.

David Jackson . . . { Pres. and Mgr. Jackson Pat. Shell Roll Co. . . . . } Pawtucket, R. I. . . . Apr. 24, 1895.

James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
John E. Kendrick . . . Vice-Pres. American Supply Co. . . . . Box 822, Providence, R. I. . . . Oct. 5, 1899.
Frank B. Kenney . . . Kitson Machine Co. . . . . Lowell, Mass. . . . Oct. 5, 1899.
William B. Kehew . . The Kehew-Bradley Co. . 24 Purchase St., Boston, Mass. . Apr. 24, 1895.

W. C. Langford . . . Oil Dealer, . . . 86 Weybosset St., Providence, R. I. . . . Apr. 27, 1899.
Josiah M. Lasell . . . Asst. Treas. Whitin Machine Works, Whitinsville, Mass. . Apr. 24, 1895.
John H. Lorimer . . . Builder of Textile Machines . . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . . Oct. 27, 1897.
Stephen C. Lowe . . . Mill Supplies . . . . 87 Union St., New Bedford, Mass. . Oct. 24, 1895.
George A. Lowry . . . Consulting Eng. Planters' Comp. Co., ... 89 State St., Boston, Mass. . . . Apr. 28, 1898.

Francis E. Macomber . Mill Supplies . . . . 21 Pearl St., Boston, Mass. . . . . Apr. 26, 1900.
F. H. Maynard . . . . Bus. Mgr. Gen. Fire Extinguisher Co., Providence, R. I. . . . Apr. 24, 1895.

H. G. McKerrow . . . Textile Machinery . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
George H. Meader . . Steam Appliances . . 35 Oliver St., Boston, Mass. . . . Apr. 24, 1895.
Charles B. Moore . . . Agt. Knowles Steam Pump Works . . . . . 54 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.
George B. Morison . . Catlen & Co. . . . 67 Chauncey St., Boston, Mass. . . . Apr. 24, 1895.

John H. Nelson . . . . Treas. William Firth Co., Box. 1460, Boston, Mass. . . . . Apr. 26, 1900.
George C. Newell . . . Starkweather & Shepley . . . . . 17 Custom House St., Providence, R. I. . . Sept. 29, 1898.
William R. Noone . . Mfr. Roller and Slasher Cloth . . . . . 100 Pearl St., Boston, Mass. . . . Oct. 27, 1897.

Sidney B. Paine . . . General Electric Co., 200 Summer St., Boston, Mass. . . . Apr. 24, 1895.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co., 13 Gold St., New York, N. Y. Apr. 28, 1897.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . Box 315, Providence, R. I. . . Apr. 24, 1895.
Vladimir P. Polevoy . { Agent Great Yaroslavskaia Cotton Mill (of Yaroslave), Russia . . . } 120 Broadway, N. Y. Apr. 28, 1897.
Charles A. M. Praray . Chas. A. M. Praray & Co., Mill Architect and Engineer . . . . . 832 and 833 Banigan Building, Providence, R. I. . . Apr. 28, 1897.

Charles F. Randall . . Expert in Textiles . . . . . Room 350, Tremont Building, Boston, Mass. . . . Apr. 24, 1895.
Peleg A. Rhodes . . . Inspector of Cotton Mills . . . . . P. O. Box 315, Providence, R. I. . . Oct. 5, 1899.
Richard H. Rice . . . Treas. Providence Engineering Work . . . . . 521 So. Main St., Providence, R. I. . . Apr. 24, 1895.
E. R. Richardson . . . Asst. Treas. American Machine Co. . Pawtucket, R. I. . . Apr. 26, 1900.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Insurance & Inspection Co. . . . . 125 Milk St., Boston, Mass. . . . Apr. 24, 1895.
Louis E. Robinson . . Cotton Agent Sea Island Cotton . . . . . 34 So. Water St., Providence, R. I. . . Oct. 27, 1897.
John M. Russell . . . Asst. Treas. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.

H. T. Schaefer . . . . Sterling Coal Co., 5 Custom House St., Boston, Mass., . . . Sept. 29, 1898.
John E. Searles . . . Pres. Am. Cotton Co., 27 William St., New York . . . . . Oct. 5, 1899.
J. Foster Searles . . . Treas. American Loom Co. . . . . Readville, Mass. . . Apr. 26, 1900.
Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
Lewis R. Speare . . { Treas. and Gen. Mgr. The Alden Speare's Sons Co., Oil and Mill Supplies } . . . . . 369 Atlantic Ave., Boston, Mass. . . . . Oct. 24, 1895.

Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.
George W. Stafford . . Mgr. Crompton & Knowles Loom Works . . . . . Providence, R. I. . . Apr. 24, 1895.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 27, 1897.
William H. Stratton . . Mgr. Factory Insurance Association . . . . . 95 Pearl St., Hartford, Conn. . . Apr. 28, 1897.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ... 34 South Water St., Providence, R. I. . . Apr. 24, 1895.
C. T. Switzler . . . . Selling Agt. The Plomo Specialty Mfg. Co. . . . . 34 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.

Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Charles F. Taylor . . . Successor to Burgess Cop Tube Co., ... 48 Custom House St., Providence, R. I. . . Apr. 28, 1898.
Winthrop Thayer . . . Pres. Thayer & Co., Incorp. . . . . 1015 Tremont Bldg., Boston, Mass. . . . Apr. 29, 1896.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . 7 Eddy St., Providence, R. I. . . Sept. 22, 1896.
William V. Threlfall . . Selling Agt. Saco and Pettee Machine Shops . . . . . Biddeford, Me. . . . Apr. 24, 1895.
Allison W. Trafford . . Mfg. of Ring Travelers . . . . . Fall River, Mass. . . Apr. 26, 1900.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Justin A. Ware . . . . Sales Mgr. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes . . . . . for Textile Manufg. . Box 996, Lowell, Mass. . . . Oct. 24, 1895.
Stephen M. Weld, . . Cotton Buyer . . . . . 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
W. W. White . . . . Agent Holyoke Machine Co. . . . Worcester, Mass. . . Apr. 27, 1899.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred A. Wilde . . . . Asst. Mgr. The A. T. Atherton Machine Co. . . . . Pawtucket, R. I. . . Apr. 28, 1897.
Erving Yale Woolley . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . . Apr. 24, 1895.

Honorary Members	5
Active Members	476
Associate Members	122
Total Membership	603

MEMBERS OF THE ASSOCIATION,

Apr. 26, 1900.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	James G. Garland	10 Adams St.
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	Joseph P. Battles	Lewiston Mach. Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	Roscoe C. Reynolds	Lewiston Machine Co.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works
Lisbon	W. H. Miles	Farwell Mills.
Saco	Elmer E. Page	York Manufg. Co.
Sanford	Louis B. Goodall	Goodall Worsted Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	John Holland	12½ Trackey St.
Exeter	Hervey Kent	Exeter Manufg. Co.

Greenville	Frederick W. Ely	Columbian Manufg. Co.
Manchester	Stephen N. Bourne	Stark Mills.
Manchester	French Campbell	75 Granite St.
Manchester	George A. Clark	Manchester Mills.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Charles D. McDuffie	Manchester Mills.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Milford	Frank E. Kaley	Morse & Kaley Manufg. Co.
Nashua	William D. Cadwell	Nashua Manufg. Co. & Jackson Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Co.
Penacook	F. E. Wattles	Boscawen Mills.
Pittsfield	George E. Kent	Exeter Manufg. Co.
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	James C. Chalmers	Renfrew Mfg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	A. B. Mole	Greylock Mill.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	James Renfrew	Renfrew Manufg. Co.
Adams	L. B. Renfrew	Renfrew Mfg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Belmont	John Kilburn	
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	B. A. Alexander	Boston Duck Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Boston	Charles B. Amory	70 Kilby St.
Boston	Frederic Amory	40 Water St.

Boston	Edward Atkinson	31 Milk St.
Boston	E. W. Atkinson	152 Congress St.
Boston	Edwin Barnes	Equitable Building.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	F. H. Bishop	226 Devonshire St.
Boston	J. Payson Bradley	24 Purchase St.
Boston	Henry G. Brinckerhoff	53 State St.
Boston	John H. Burghardt	31 Pearl St.
Boston	Alfred Clarke,	23 Central St.
Boston	Frank B. Comins	150 Devonshire St., Room 67.
Boston	Alphonse S. Covel	70 Kilby St.
Boston	Augustus De Cort	P. O. Box 2815.
Boston	P. Y. DeNormandie	30 Kilby St.
Boston	Ambrose Eastman	53 State St.
Boston	William Firth	150 Devonshire St.
Boston	Redington Fiske	89 State St.
Boston	Alfred M. Goodale	50 State St.
Boston	Stephen Greene	131 Devonshire St.
Boston	Richard H. Hill	70 Kilby St.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	140 Essex St.
Boston	Henry S. Howe	68 Chauncy St.
Boston	William B. Kehew	24 Purchase St.
Boston	Evan Arthur Leigh	70 Kilby St.
Boston	William C. Lovering	40 Water St.
Boston	George A. Lowry	89 State St.
Boston	Herbert Lyman	P. O. Box 1717.
Boston	Francis E. Macomber	21 Pearl St.
Boston	Charles T. Main	1112 Exchange Building.
Boston	Fred C. McDuffie	40 Water St.
Boston	H. G. McKerrow	31 State St.
Boston	George H. Meader	35 Oliver St.
Boston	Charles B. Moore	54 Oliver St.
Boston	George B. Morison	67 Chauncey St.
Boston	John H. Nelson	P. O. Box 1460.
Boston	William R. Noone	100 Pearl St.
Boston	Sidney B. Paine	200 Summer St.
Boston	Francis J. Parker	81 Milk St.
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Charles F. Randall	350 Tremont Building.
Boston	Charles E. Riley	281 Congress St.
Boston	C. E. Roberts	125 Milk St.
Boston	Arnold B. Sanford	67 Chauncey St.
Boston	H. T. Schaefer	5 Custom House St.
Boston	George H. Shapley	78 Chauncey St.
Boston	William F. Sherman	27 State St.
Boston	Lewis R. Speare	369 Atlantic Ave.

Boston	C. T. Switzler	34 Oliver St.
Boston	Winthrop Thayer	1015 Tremont Building.
Boston	James P. Tolman	115 Congress St.
Boston	Charles D. Turnbull	The Ludlow.
Boston	Frank H. Underwood	137 Purchase St.
Boston	Stephen M. Weld	Cotton Buyer, 89 State St.
Boston	Erving Yale Woolley	152 Congress St.
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Cambridgeport	Henry B. Sprague	Boston Woven Hose & Rubber Co.
Canton	Willis S. Shepard	Amer. Net & Twine Co.
Canton Junction	Joseph W. Wattles	Manufacturers' Supplies.
Chestnut Hill	J. Herbert Sawyer	
Chicopee Falls	Henry A. Bailey	Chicopee Manufg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	John R. Rostron	Lancaster Mills.
Clinton	George P. Taylor	Danielsonville Cotton Co.
Clinton	George W. Weeks	
East Hampton	William B. Fitz	
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Agt. for Card Clothing Manufr.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Troy C. & W. Manufg. Co.
Fall River	Thomas J. Borden	Richard Borden Manufg. Co.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	George A. Chace	Bourne Mills.
Fall River	Simeon B. Chase	King Phillip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	B. D. Davol	Barnard Manufg. Co.
Fall River	Frank H. Dwelly	Tecumseh Mills.
Fall River	David H. Dyer	6, 7 and 8 Pocasset Bank Building.
Fall River	William Evans	Richard Borden Manufg. Co.
Fall River	John T. Fyans	411 Beach St.
Fall River	Daniel Gilligan	Pocasset & Metacomet Mills.
Fall River	Effingham C. Haight	Wampanoag Mills.
Fall River	A. M. Hamilton	Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160.
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	Samuel E. Hathaway	Fall River Iron Works Co.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	P. O. Box 733.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co
Fall River	Edward B. Jennings	N. E. Cotton Yarn Co.
Fall River	Benjamin B. Kirk	Fall River Iron Works Co.
Fall River	George H. Law	815 Walnut St.

Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	J. Edward Osborne	American Linen Co.
Fall River	Herbert W. Owen	Merchants' Mfg. Co.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	Robert Stewart	Shove Mills.
Fall River	John Sullivan	Union Cotton Manufg. Co.
Fall River	Timothy Sullivan	Davol Mills.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	Horace W. Tinkham	Robeson Mills.
Fall River	Allison W. Trafford	Mfr.
Fall River	George F. Tryon	199 Purchase St.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Joseph Watters	Osborn Mills.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	123 Myrtle Ave.
Fitchburg	John Leiper	Fitchburg Worsted Mills.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomspon	Parkhill Manufg. Co.
Great Barrington	Jno. H. C. Church	Monument Mills.
Griswoldville	James C. Deane	Griswoldville Manufg. Co.
Holyoke	Jones S. Davis	6 Newton Street.
Holyoke	John W. Dickinson	Lyman Mills.
Holyoke	Ernest Lovering	Lyman Mills.
Holyoke	W. Marshall Taylor	Merrick Thread Co.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	William F. Draper, Jr.	Draper Co.
Housatonic	T. G. Ramsdell	Monument Mills.
Hyde Park	T. B. Stevenson	Readville Mill.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	123 Hampden St.
Ipswich	James W. Brown	Box 312.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	A. W. Brainerd	P. O. Box 33.

Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	May St.
Lawrence	William J. Hadfield	225 Bailey St.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	217 Haverhill St.
Lawrence	Henry C. Phillips	Atlantic Cotton Mill.
Lawrence	Robert Redford	
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	George W. Towne	Arlington Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Lawrence	Eben C. Willey	Atlantic Cotton Mills.
Leicester	Charles A. Denny	American Card Clothing Co.
Linwood	Arba C. Slater	Linwood Mill.
Linwood	Fred B. Whitin	Uxbridge Cotton Mills.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Machinery and Pulley Manufacturer
Lowell	Clarence N. Childs	43 Pine St.
Lowell	Alonzo A. Coburn	Atherton Machine Co.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Mfr.
Lowell	Albert W. Danforth	881 Bridge St.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	William A. Eastman	Lowell Hosiery Co.
Lowell	T. C. Entwistle	Cor. Market and Northern Sts.
Lowell	James T. Ferguson	Boott Mills.
Lowell	Frederick A. Flather	Lowell Machine Shop.
Lowell	Royal W. Gates	307 Market St.
Lowell	Sumner S. Gould	Lowell Branch Am. Card Clo. Co.
Lowell	William E. Hall	Shaw Stocking Co.
Lowell	James G. Hill	Merrimack House.
Lowell	George L. Hooper	7 Belmont Street.
Lowell	Frank B. Kenney	Kitson Machine Co.
Lowell	Nathaniel B. Kerr	Boott Cotton Mills.
Lowell	Alvin S. Lyon	Lowell Manufg. Co.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimac Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Edward W. Thomas	Tremont and Suffolk Mills.
Lowell	Charles T. Upton	Shaw Stocking Co.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.

Lowell	Frederick T. Walsh	Lowell Bleachery & Dye Works.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lynn	C. J. H. Woodbury	Secy. and Treas.
Manchaug	Charles M. Holmes	Manchaug Co.
Medford	H. B. Ashton	153 Adams St.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
New Bedford	George A. Ayer	123 Fifth St.
New Bedford	Christopher P. Brooks	New Bedford Textile School.
New Bedford	Robert Burgess	Grinnell Mfg. Corp.
New Bedford	Byron F. Card	Howland Mills.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Thomas Horsfield	95 Bonney St.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	Stephen C. Lowe	87 Union St.
New Bedford	Albert R. Pierce	Pierce Mfg. Corporation.
New Bedford	Andrew G. Pierce, Jr.	Box 34.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.
New Bedford	Benjamin Wilcox	City and Bristol Mfg. Co.
Newton	Josiah G. Coburn	99 Washington St.
Newtonville	O. B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. P. Snelling	Saco and Pettee Machine Shops.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.
North Adams	Charles W. Dennett	Johnson Manufg. Co. and Dunbar Mills Co.
North Adams	J. F. Powers	Eagle Mill.
Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Cambridge	Colin C. Bell	Laminar Fibre Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Oakdale	Alfred N. Whiting	L. M. Harris Manufg. Co.
Readville	J. Foster Searles	American Loom Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullen	Naumkeag Steam Cotton Co.
Salem	N. G. Simonds	Naumkeag Steam Cotton Co.
Saundersville	Thomas Wilmarth	Saunders Cotton Mills.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
Shirley	Henry D. Martin	
Smithville, Barre	George W. Robbins	White Valley Mills.

South Hadley Falls	William R. Hill	Glasgow Manufg. Co.
Springfield	Joseph M. Dunham	43 Edwards St.
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	John J. Connell	Cohannet Mills.
Taunton	Peter H. Corr	38 Court St.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	P. T. Creed	Hopewell Mills.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mill.
Taunton	Herbert Fisher	
Taunton	Abbott F. Lawrence	Winthrop Cotton Yarn Co.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	Canoe River Mills.
Taunton	Joseph S. Tidd	Oakland Mills.
Thorndike	Charles H. Hobbs	Thorndike Co.
Three Rivers	Roscius C. Newell	Palmer Mill.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Charles L. Bailey	
Waltham	Arthur C. Freeman	97 Church St.
Waltham	Charles E. Getchell	35 Willow St.
Waltham	Arthur H. Gulliver	Boston Mfg. Co.
Ware	George E. Tucker	The Otis Co.
Webster	Ernest E. Clark	H. N. Slater Mills.
West Warren	George A. Moody	Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Winchendon	Z. L. White	White Brothers.
Worcester	George Crompton	Crompton & Knowles Loom Works.
Worcester	Randolph Crompton	Crompton & Knowles Loom Works.
Worcester	Henry F. Harris	Room 509, State Mutual Building.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works.
Worcester	F. H. Rice	394 Pleasant St.
Worcester	John M. Russell	Crompton & Knowles Loom Works.
Worcester	Justin A. Ware	Crompton & Knowles Loom Works.
Worcester	W. W. White	Holyoke Machine Co.
Worcester	Theop. W. Wilmarth	Inspecting Engineer American Steel and Wire Co.

RHODE ISLAND.

Allenton	R. A. Gray	Rodman Manufg. Co.
Ashton	Charles H. Collins	Berkeley Co.
Bayside	Abel T. Atherton	Machine Maker.
Central Falls	Stephen L. Adams	Stafford Manufg. Co.
Central Falls	Louis B. Barker	United States Cotton Co.
Central Falls	O. B. Parker	U. S. Cotton Co.
Centreville	Harold Lawton	Warwick Mills.
Centreville	Robert B. Treat	Centreville Cotton Mills.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Fiskville	James Gee	Interlaken Dye Works.
Georgiaville	Herbert R. Farnum	Bernon Mills.
Hamilton	Joseph Warren Greene	Hamilton Web Co.
Lonsdale	Edward A. Mongeon	Lonsdale Co.'s Mills.
Manville	Charles Henry Savage	Manville Co.
Manville	A. Tenny White	Manville Co.
Pawtucket	William W. Blades	135 Mineral Spring Ave.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	John J. Hart	Charlton Manufg. Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	B. F. G. Linnell	Greene & Daniels Mfg. Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	E. R. Richardson	American Machine Co.
Pawtucket	F. C. Sayles	Ponemah and Baltic Mills.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Hope Co. and Phenix Mill.
Pontiac	Walter H. Summersby	Pontiac Mill and Bleachery.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	47 Charles St.
Providence	H. C. Atwood	Williamsville Manufg. Co.
Providence	George R. Babbitt	182 South Water St.
Providence	Edward R. Ballou	189 Charles St.
Providence	Truman Beckwith	Dyerville Manufg. Co.
Providence	J. Frank Braids	212 Weybosset St.
Providence	D. Russell Brown	Brown Bros. Co.
Providence	H. Martin Brown	Brown Bros. Co.
Providence	E. C. Bucklin	Harris Manufg. Co. and Interlaken Mills.
Providence	Fred N. Bushnell	Narragansett Electric Light Co.
Providence	Albert L. Calder, 2nd	P. O. Box 206.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Henry C. Clark	Standard Mill Supply Co.
Providence	Frederick I. Dana	Thomas Phillips Co.

Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co.
Providence	R. H. Deming	10 South Water St.
Providence	J. Herbert Foster	10 South Water St.
Providence	William Gammell	Berkeley Co.
Providence	Rufus B. Goff	77 Exchange Place.
Providence	William S. Granger	Granger Foundry & Machine Co.
Providence	Henry T. Grant, Jr.	723 Banigan Building.
Providence	David Grove	610 Manton Avenue.
Providence	John H. Hambly	49 Westminster St.
Providence	A. Walter Harris	326 South Water St.
Providence	Elisha H. Howard	309 Butler Exchange.
Providence	W. L. Hutchins	Crompton & Knowles Loom Works.
Providence	John E. Kendrick	American Supply Co.
Providence	Jesse A. Knight	Lawton Spinning Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Webster Knight	Natick Mills.
Providence	W. C. Langford	86 Weybosset St.
Providence	Charles Warren Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Mill Engineer.
Providence	A. T. Malcolmson	C. Bischoff & Co.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	26 Olney St.
Providence	George C. Newell	17 Custom House St.
Providence	William C. Peirce	564 Eddy St.
Providence	Reuben Pilling, Jr.	30 Hudson St.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	832-833 Banigan Building.
Providence	Peleg A. Rhodes	P. O. Box 315, also Banigan Bldg.
Providence	Richard H. Rice	521 South Main St.
Providence	Walter Rigby	189 Charles St.
Providence	Louis E. Robinson	34 So. Water St.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Harry M. Smith	77 Exchange Place.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	George W. Stafford	Crompton & Knowles Loom Works.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert Rennie Taft	P. O. Box 1443.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	48 Custom House St.
Providence	D. M. Thompson	B. B. & R. Knight's Mills.
Providence	A. Curtis Tingley	7 Eddy St.
Providence	William P. Vaughan	Banigan Building.
Quidnick	Albert Knight	Quidnick Mills.

Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen Mills.
Riverpoint	C. Prescott Knight	Riverpoint Corp.
Slatersville	William P. Holt	Wm. A. Slater Mills Corp.
Valley Falls	Andrew J. Currier	Albion & Valley Falls Co.
Warren	Arnold Schaer	Warren Manufg. Co.
Warren	John Waterman	Warren Manufg. Co.
Westerly	Louis L. Hohn	122 High St.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	Henry S. Houghton, Sr.	61 Pond St.
Woonsocket	Albert C. Hoy	Hamlet Mills.
Woonsocket	Albert F. Knight	39 Main Street.
Woonsocket	Charles H. Merriman, Jr.	Social Manufg. Co.
Woonsocket	William A. Robinson	Social Manufg. Co.
Woonsocket	Earl A. Thissell	Woonsocket Bobbin Co.
Woonsocket	Ariel C. Thomas	93 Clinton St.
Woonsocket	Charles E. Thomas	44 Prospect St.
Woonsocket	William Whittam, Jr.	Lawton Spinning Co.

CONNECTICUT.

Danielson	James Herbert Smith	Quinebaug Mills.
Dayville	C. H. Truesdell	Attawaugan Co.
Hartford	William H. Stratton	95 Pearl St.
Jewett City	J. Colby Lewis	Wm. A. Slater Mills Corp.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Montville	Emory S. Rathbun	Pequot Mills.
New Hartford	Robert R. Smith	Greenwoods Co.
New Haven	George S. Barnum	The Bigelow Co.
No. Grosvenor Dale	Frank M. Messenger	Grosvenor Dale Co.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	
Norwich	C. H. Frisbie	Attawaugan Co.
Norwich	W. G. Henderson	Shetucket Co.
Norwich	Moses Pierce	274 Broadway.
Norwich	John F. Reardon	Falls Co.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Uncasville	Charles D. White	Uncasville Manufg. Co.
Wauregan	James A. Atwood	Wauregan Mills & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Mills.
Willimantic	E. S. Boss	Willimantic Linen Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willow Vale Bleaching Co.
Cohoes	David S. Johnston	Cohoes Iron Foundry & Machine Co.
Cohoes	John R. Mason	237 Main St.
Cohoes	John E. Prest	Harmony Mills.
Jamestown	Thomes Henry Smith	Jamestown Cotton Mill.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	117 Duane St.
New York City	D. C. Ball	American Cotton Co.
New York City	Percy H. Brundage	290 Broadway.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	John W. Ferguson	Postal Telegraph Building.
New York City	Dudley T. Lyall	541 West 23rd St.
New York City	William L. Lyall	540 West 23rd St.
New York City	Arthur B. Mann	99 Franklin St.
New York City	Arthur Parkinson	13 Gold St.
New York City	Duncan D. Parmly	49 Wall St.
New York City	Vladimir P. Polevoy	120 Broadway.
New York City	John E. Searles	American Cotton Co.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
Oswego	George H. Sayward	Standard Yarn Co.
Utica	George DeForest	Utica Steam Cotton Mills.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica	John B. Wild	Oneita Knitting Mills.
Victory Mills	Joseph O. Hannum	Saratoga Victory Manufg. Co.

NEW JERSEY.

Gloucester City	Philip H. Fowler	
Gloucester	George W. Turner	Argo Mills.
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Millville	John K. Russell	May's Landing Water Power Co. and Millville Mfg. Co.
Newark	William H. Loftus	Clark Thread Co.
New Brunswick	William H. Ritter	Johnson & Johnson.
Yardville	Charles F. Farrar	Groveville Mills.

PENNSYLVANIA.

Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Chester	W. T. Galey	Aberfoyle Manufg. Co.

Lancaster	S. S. Spencer	Conestoga Steam Mills.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
Philadelphia	Robert Beatty	Coral and Adams Sts.
Philadelphia	T. Ashby Blythe	114 Chestnut St.
Philadelphia	Alfred H. Burnham	Glasgow Mills.
Philadelphia	Harry W. Butterworth	York and Cedar Sts.
Philadelphia	James Butterworth	York and Cedar Sts.
Philadelphia	Frederick A. Downes	925 Chestnut St.
Philadelphia	Edward W. France	N. W. Cor. Broad and Pine Sts.
Philadelphia	Merrill A. Furbush	428-430 Philadelphia Bourse.
Philadelphia	Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford.
Philadelphia	John T. Greenwood	4720 Leiper St.
Philadelphia	H. S. Grove	218 Race St.
Philadelphia	W. C. Houston	333 Drexel Building.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave. and 11th St.
Philadelphia	George Wood	626 Chestnut St.
Philadelphia	John P. Wood	Spring Garden and 22nd Sts.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.
Wilmington	Daniel Moore Bates, Jr.	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	James A. Gary	108 W. German St.
Baltimore	Charles K. Oliver	346-8 Equitable Bld.

NORTH CAROLINA.

Charlotte	R. M. Miller, Jr.	Atherton Mills.
Charlotte	D. A. Tompkins	D. A. Tompkins Co.
Charlotte	Arthur Whittam	Textile Excelsior.
Charlotte	J. P. Wilson	Dover Yarn Mills.
Durham	O. W. Stiles	Commonwealth Cotton Mfg. Co.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Greensboro	Edward T. Garsed	Hucomuga Mills.
Hope Mills	Frank H. Cotton	Hope Mills Mfg. Co.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.

SOUTH CAROLINA.

Bath	Henry P. Meikleham	Aiken Mfg. Co.
Chester	William G. Nichols	Springstein Mills.

Columbia	James Sumter Moore	Olympia & Richland Cotton Mills.
Columbia	W. B. Smith-Whaley	1328 Main St.
Gaffney	H. D. Wheat	Gaffney Manufg. Co.
Gaffney	Edward B. Wilbur	Gaffney Mfg. Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Orangeburg	Samuel Dibble	The Enterprise Cotton Mills.
Pelzer	B. F. Guy	Pelzer Manufg. Co.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.
Union	T. C. Duncan	Union Cotton Mills.

GEORGIA.

Atlanta	C. E. W. Dow	40 So. Forsyth St.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	William M. Nixon	Atlanta Woolen Mills.
Atlanta	James R. Pearce	Fulton Bag and Cotton Mills.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	Charles Estes	John P. King Mfg. Co.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Augusta	Eugene F. Verdery	Warren Mfg. Co.
Augusta	James P. Verdery	Enterprise Mfg. Co.
Columbus	E. N. Clemence	Eagle & Phenix Mills.
Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.
Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
Lindale	Edward C. Beach	Mass. Mills In Georgia.
Macon	W. H. Richmond	Bibb Mill No. 2.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	C. C. Cowan	Memphis Cotton Exchange.
Memphis	Jerome Hill	334 Front St.
Nashville	T. B. Dallas	Phoenix Cotton Mills, Dallas Mfg. Co.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.

ALABAMA.

Birmingham	B. B. Comer	Avondale Cotton Mills.
Cordova	Albert W. Dimick	Indian Head Mills.
Huntsville	A. W. Hunking	Merrimack Mfg. Co.
Huntsville	T. W. Pratt	West Huntsville Cotton Mill Co.
Langdale	Charles M. Sears	West Point Mfg. Co.

TEXAS.

Galveston	Lawrence V. Elder	212 Tremont St.

CANADA.

Province of Ontario.

Hamilton, Ont.	Charles Owen Dexter	The Canadian Colored Cotton Mills Co., Ltd.
Hamilton, Ont.	James M. Young	Hamilton Cotton Co.

Province of Quebec.

Cornwall, P. Q.	S. Greenwood	Canadian Col'd Cot. Mills Co.
Hochelaga, P. Q.	W. S. Hume	176 Notre Dame St.
Montreal, P. Q.	Alfred Hawkesworth	Merchants Cotton Co.
Montreal, P. Q.	Fred Hawkesworth	Merchants Cotton Co.
Magog, P. Q.	Harry W. Kimball	Dominion Cotton Mills Co.
Montreal, P. Q.	D. K. McLaren	751 Craig St.
Valleyfield, P. Q.	Fred Lacey	Montreal Cotton Co.
Valleyfield, P. Q.	Louis Simpson	

NEW BRUNSWICK.

Marysville	John B. Cudlip	Gibson Cotton Mills.
Milltown	Lewis Dexter, Jr.	The Canadian Colored Cotton Mills Co., Ltd.
Milltown	Farquharson J. Muir	The Canadian Colored Cotton Mills Co., Ltd.
St. John	John H. Parks	Wm. Parks & Son, Ltd.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	19
New Hampshire	28
Vermont	1
Massachusetts	296
Rhode Island	107
Connecticut	26
New York	26
New Jersey	8
Pennsylvania	20
Delaware	2
Maryland	2
North Carolina	11
South Carolina	12
Georgia	18
Tennessee	4
Louisiana	1
Kentucky	1
Alabama	5
Texas	2
Province of Ontario	2
Province of Quebec	8
New Brunswick	4
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IN MEMORIAM.

JOHN DROWNE.

Mr. JOHN DROWNE, late Superintendent of the Cocheco Mfg. Co., Dover, N. H., whose death occurred at Bristol, R. I., January 27, 1900, was born at Eaton, N. H., in 1846. He received his early education in the district and high schools of the town, and at the age of eighteen enlisted in the 18th New Hampshire Regiment and saw much service, especially with the 9th Army Corps in front of Petersburg. At the close of the war, receiving an honorable discharge, he began his cotton mill career by entering the employment of the Atlantic Cotton Mills at Lawrence, Mass., in the weaving department, remaining there until the fall of 1869, when he accepted the position of Overseer of Weaving in the Houston Mills at Houston, Tex. The climate and general surroundings not being congenial, Mr. DROWNE remained South but a year, returning to the Atlantic Mills, and there remaining until 1874. He then accepted an offer in the weaving department of the Greenwoods Mfg. Co., New Hartford, Ct., but a short time after again changed for a better position with the Wamsutta Mills, New Bedford, remaining with this Company until 1880. His short stay at New Hartford, however, was sufficient to demonstrate his ability, so that when in 1880 the Greenwoods Co. required the services of a superintendent, Mr. DROWNE was chosen for the position. From this date until March 1896 he remained with this compamy, filling the position with credit.

But again he was called to a larger field of usefulness, and, being perhaps influenced by a desire to return to his native state, he accepted the position of Superintendent of the Cocheco Mfg. Co., which he most ably filled up to the time of his death.

With all the instincts of a true gentleman and with unusual ability in his chosen work, the success which JOHN DROWNE attained was not to be wondered at. Careful and painstaking, always ready to do his duty to both employer and employee, no matter how disagreeable or how difficult it might be, his death has caused a vacancy in our ranks, in the filling of which our younger members can do no better than to model from the man himself.

Mr. DROWNE was prominent in Masonry, being a member of the Amos Beecher Lodge, New Hartford, Ct.; of the Washington Commandery Knights Templers of Hartford, and the Lafayette Consistory, Bridgeport, Ct. He was also prominently associated with the I. O. O. F., being a member of the Monadnock Lodge, Lawrence, and the Anawam Encampment, New Bedford.

He became a member of the New England Cotton Manufacturers' Association April 29, 1896.

JOSEPH H. KENDRICK.

Col. JOSEPH H. KENDRICK died at Providence, R. I., February 20, 1900, closing a career of great activity and prominence which was marked by continuous evidences of confidence in his integrity and strength of character. He was one of the oldest of New England families and was born at Winchester, N. H., March 19, 1831. He received a common school education, after which he was employed in the loom harness business started by his eldest brother. In this work the family were pioneers, as every mill had made its own harnesses up to that

time. He entered into partnership with his brother and added the manufacture of reeds to that of harnesses, changing the place of business to Worcester, and in 1851 to Providence. In the course of time the business becoming enlarged in its functions, was incorporated and joining with other interests became the American Supply Company, of which corporation he was the agent for the remainder of his life.

Col. KENDRICK became a member of this Association April 30, 1879, and took an active part in the discussions before the meeting, for which his thorough knowledge of cotton manufacturing both as to the process and the machinery, and his ability as an attractive public speaker rendered him peculiarly well qualified. His paper at the sixty-fifth meeting of the Association held at the Crawford House in the White Mountains, September 1898, on "The Manufacture, Use and Care of Loom Harnesses and Reeds", was a unique contribution to an important subject upon which there is but little in print.

He entered the Federal army as a private in the 11th Rhode Island Infantry in September, 1862, and before the end of his term of service had been promoted to captain. After the war he was identified with the Rhode Island militia and afterwards became colonel of the First Regiment and of the First Light Infantry Regiment, maintaining his connection with the militia until about two years ago.

He was interested in music, and for many years was the leading bass singer in the choir of the Union Congregational Church and also a member of the principal musical society of Providence.

He was a member of the Young Men's Christian Association, of the Masons, Odd Fellows, Grand Army of the Republic, Sons of American Revolution, Providence Board of Trade and the Squantum Association, and for many years he was a member of the Common Council and at the time of his death was president of that body.

He was first married in 1856 to ABBY B. ARNOLD who died in 1888. In 1890 he married HELEN M. COOK who survives him. His career is a notable example of the results of an indus-

trious, busy life to which he assiduously devoted himself with skill, to his compliance with the duties placed upon him by the numerous calls to public duty, and was a model in the personal and domestic relations of life.

WILLIAM L. HUTCHINS.

WILLIAM L. HUTCHINS, Assistant Superintendent of the Crompton & Knowles Loom Works at Providence, R. I., was instantly killed by an accident on May 9, 1900. Mr. HUTCHINS was about 28 years of age, the son of Mr. GEORGE F. HUTCHINS, the General Superintendent of the Crompton & Knowles Loom Works, and the nephew of Mr. C. HENRY HUTCHINS, President of this Company. He has been located at the Providence Department as Assistant Manager for about six years. He was a young man of sterling worth and of fine ability as a mechanic, and his services were most highly prized by the company with which he was connected. He was very popular in every sense and universally respected by all with whom he came in contact. His wife and two children survive him.

Mr. HUTCHINS became a member of this Association April 28, 1898.

ROBERT R. SMITH.

ROBERT R. SMITH, Manager of the Greenwoods Company at New Hartford, Conn., died on May 12, 1900. He was born at New Hartford, Conn. April 15, 1843, and was the son of JOHN C. SMITH, who was one of the pioneer manufacturers in Connecticut, forming the Greenwoods Company in 1848, on the

water power of the Farmington River which was first developed in 1810. In 1869 he was appointed agent of the Greenwoods Scythe Co. and on the death of his father took charge of the Greenwoods Co., which mills have been devoted to the manufacture of cotton ducks and other heavy fabrics, especially cotton belting and special fabrics which form the foundation of rubber belting and similar goods. The product of these works has been very widely sold, not merely over the United States, but has a large market in foreign countries which has given to this mill an unusually regular operation.

Mr. SMITH was twice married; first, in June, 1867, to Miss MINNIE M. SIMMONS, who died March 21, 1890. In June, 1892, he married Miss ALBERTA HOOPER of Baltimore, who survives him. He became a member of this Association October 19, 1870, and has been constant in his attendance at the meetings and frequently contributed more to the discussions than his modesty permitted to appear in the printed record. He was affiliated with the Congregational Church, the Masons and other organizations.

The funeral services were attended by a great many in the community in which he had taken such an active part, and his active life had been led in such an upright manner as to win the regard and respect of those who had been closely associated with him.

PROCEEDINGS.

In accordance with the legal notice, the stated semi-annual meeting of the Association was held in Chipman Hall, Boston, Mass., April 25th and 26th, 1900. The following 327 members and guests were present:

ACTIVE MEMBERS.

ALFRED E. ADAMS, Whitinsville, Mass.
JOHN S. ADAMS, JR., Adams, Mass.
STEPHEN L. ADAMS, Central Falls, R. I.
JOSEPH D. AIKEN, Taftville, Conn.
CHARLES T. ALDRICH, Providence, R. I.
EDWARD ATKINSON, Boston, Mass.
H. C. ATWOOD, Providence, R. I.
W. E. ATWOOD, Killingly, Conn.
GEORGE A. AYER, New Bedford, Mass.
EDWARD R. BALLOU, Providence, R. I.
LOUIS B. BARKER, Central Falls, R. I.
LEWIS E. BARNES, Methuen, Mass.
EDWIN N. BARTLETT, North Oxford, Mass.
DANIEL MOORE BATES, JR., Wilmington, Del.
JOSEPH P. BATTLES, Lewiston, Me.
GEORGE W. BEAN, Lewiston, Me.
ROBERT BEATTY, Philadelphia, Pa.
TRUMAN BECKWITH, Providence, R. I.
RICHARD B. BORDEN, Fall River, Mass.
FRANK A. BOWEN, Lowell, Mass.
ARTHUR F. BRACKETT, Riverpoint, R. I.

A. W. BRAINERD, Lawrence, Mass.
CHRISTOPHER P. BROOKS, New Bedford, Mass.
HENRY R. BROWN, Phenix, R. I.
JAMES W. BROWN, Ipswich, Mass.
O. S. BROWN, Salmon Falls, N. H.
EDWARD N. BURKE, Lowell, Mass.
HERVEY BURNHAM, North Adams, Mass.
W. R. BURNHAM, Norwich, Conn.
ERNEST E. CLARK, Webster, Mass.
FRANK B. COMINS, Boston, Mass.
B. B. COMER, Birmingham, Ala.
JOHN J. CONNELL, Taunton, Mass.
P. T. CREED, Taunton, Mass.
H. H. CULVER, Taunton, Mass.
HENRY S. CULVER, Taunton, Mass.
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GEORGE OTIS DRAPER, Hopedale, Mass.
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HERBERT FISHER, Taunton, Mass.
WILLIAM B. FITTZ, Easthampton, Mass.
FREDERICK A. FLATHER, Lowell, Mass.
M. F. FOSTER, Milford, N. H.
ARTHUR C. FREEMAN, Waltham, Mass.
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R. A. GRAY, Allenton, R. I.
MAXWELL GRIERSON, Jersey City, N. J.
H. S. GROVE, Philadelphia, Pa.
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WILLIAM J. HADFIELD, Lawrence, Mass.
Z. D. HALL, Adams, Mass.
JOSEPH O. HANNUM, Victory Mills, N. Y.
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FRED HAWKESWORTH, Montreal, P. Q.
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T. G. RAMSDELL, Housatonic, Mass.
JOHN F. REARDON, Norwich, Conn.
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JOHN B. WILD, Utica, N. Y.
C. J. H. WOODBURY, Lynn, Mass.

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Somerfield Baldwin, Baltimore, Md.
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Everett Burnham, Boston, Mass.
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Lyman Clark.
F. S. Cooley, Philadelphia, Pa.

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GEORGE K. MALTBY, Boston, Mass.
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GEORGE H. WAIT.
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H. A. WHITE, Philadelphia, Pa.
DR. W. P. WILSON, Philadelphia, Pa.
GEORGE F. WOODLEY, Providence, R. I.
JAMES T. WOODWARD, Boston, Mass.

FIRST SESSION.

CHIPMAN HALL, BOSTON, MASS.
Wednesday, April 25, 1900.

Meeting called to order at 11 A. M., President D. M. THOMPSON in the chair.

The Secretary read the following call to the meeting:

BOSTON, MASS., April 2, 1900.

To the Members —

Notice is hereby given that the stated Annual Meeting of this Association will be held at Boston, Mass., Wednesday and Thursday, April 25 and 26, 1900.

The sessions will be held in Chipman Hall, in the Tremont Temple, No. 88 Tremont Street, a short distance south of School Street, and opposite the Tremont Building. The entrance is at No. 88 Tremont Street, and Chipman Hall is on the sixth floor, reached by elevators.

The sessions will be called to order on Wednesday at 11 A. M., and 2 P. M., and on Thursday at 10 A. M., and 2 P. M.

By order of the Board of Government,

C. J. H. WOODBURY,

Secretary.

The National Association of Manufacturers will hold its fifth annual convention in Boston on April 24–26 and there will also be two other conventions in the city at the same time, and on account of the unusual number of guests expected at the Boston Hotels, it may be a convenience

if members engage their hotel accommodations as early in advance as possible. The following hotels are in the vicinity of the hall, or reached conveniently by electric cars: Parker's, Young's, Touraine, Thorndike and Copley Square Hotels on the European plan, and Brunswick, American and Quincy Hotels on the American plan.

It is expected that there will be an interchange of courtesies with the National Association of Manufacturers, and for this reason, it is of special importance to the convenience of those members who expect to attend the meeting that the Secretary should receive the enclosed postal card notices from those who expect to be present.

The Citizens' Committee are to give a banquet to the National Association of Manufacturers at Mechanics Hall, Boston on Thursday, April 26, at 6.00 P. M., preceded by a reception at 5 P. M., at which it is expected that President McKINLEY, members of the Cabinet, representatives of the diplomatic corps and others eminent in public life will be present, for which occasion members of the Association can obtain dinner tickets by enclosing check for $10, payable to the order of the Banquet Committee, 45 Milk St., Room 57, Boston, Mass., and tickets admitting ladies to the balconies will be given with each dinner ticket without charge, if desired.

The New England Telephone and Telegraph Co. will place two telephone booths in the corridor outside of the hall for the free use of the members for Boston and vicinity during the day, and before 10.00 A. M. and after 4.00 P. M., free telephone service over the states of Maine, New Hampshire, Vermont and Massachusetts. The American Telephone and Telegraph Co. will give free long distance service to members beyond this territory before 10.00 A. M. and after 6.00 P. M. In this, as in all the other privileges of the Association, candidates for membership will receive the same privileges as the members.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

It is desired that applications for membership shall be received as far as possible in advance of the meetings. Blank propositions are enclosed herewith and may be found on the inside cover of the Transactions, or will be sent on application.

Members who have overlooked their postal card receipts for Transactions are requested to give the matter attention, as it is only through

this means that the headquarters of the Association are able to know that members receive the volumes and notices to which they are entitled.

Friends of our late President, Mr. FREDERICK E. CLARKE, of Lawrence, have compiled a memorial volume containing resolutions from the various organizations and interests with which he was identified and also addresses upon his career. Copies of the book will be mailed for $1.00 each by Mr. J. C. CROMBIE of Lawrence, Mass.

The papers will be printed in advance for the use of the members as usual as far as the manuscript may be sent to the Secretary.

The full programme will not be issued until the meeting, but papers are expected on the following subjects:

Ring Spinning.
The Height and Area Required for Chimney Draft.
Belting.
Systems of Payment on Mules.
Southern Cotton Manufacturing.
Lighting Buildings by Reflected Sunlight.
Costs.
Application of Forced Draft to Stationary Boilers.
Utilization of Waste Products of Cotton Mills.
The Trade of Latin America in Cotton Goods.
Heating and Ventilating of Mills.
Cotton Mixing.

The following topical questions will be in order as occasion affords during the meeting. If any member wishes to propose other topical questions, or will engage in the discussion of any of them, the President will reserve the floor for him.

TOPICAL QUESTIONS.

119. In which class of machinery, as at present running, is it desirable to improve the most to obtain a minimum cost in manufacturing?

120. English practice has been in the direction of separating the business of spinning from that of weaving. What are the advantages of this separation? Is there any such tendency discernible in American practice at the present time?

121. What can be offered on the subject of the influence of moisture in the air affecting the strength of yarn?

122. What is the best temperature and humidity for good spinning on fine counts?

123. What is the best way to prevent double yarn on spinning frames where double boss rolls are used?

124. What is the best covering for the top rolls used on frames and mules that are to spin various numbers?

125. What is the best taper or length of wind for mule cops on number 37 filling?

126. Is it practical to spin numbers finer than 65s on larger rings than 1½ with spindle running 9,000 revolutions?

127. What is the maximum length to put No. 100s on bobbin?

128. How far is it practicable to substitute frames for mules in spinning filling?

129. What means have been found useful in diminishing the number of oil stains?

130. What steam pressure should be carried on slashers running on colored work, and what is the best means of returning to boilers the condensation from slashers?

131. What is the quantity of steam properly required for slashers and the best means of applying the same?

132. What is the best method of utilizing the waste products of a mill?

133. What is the best method of treating belts and their proper use?

134. Is it advisable to warm picker rooms with air drawn from the main mill?

135. Are automatic heat regulators an advantage both in economy and comfort?

136. What is the best method of cleaning mill windows?

138. What is the best method of introducing kerosene oil into boilers, and what have been the results from its use?

139. Do water tube boilers contain advantages for steam plants in mills?

140. Do separators remove enough of the oil from condensed steam to prevent all injury to the boilers?

The SECRETARY. In accordance with Article 14 of the by-laws, I certify that this call was mailed to each member at least ten days before the meeting and that a quorum is now present.

PROGRAMME, ANNUAL MEETING, NO. 68.

CHIPMAN HALL, 88 TREMONT ST., BOSTON, MASS., APRIL 25–26, 1900.

First Session, Wednesday, April 25, 1900, at 11 A. M.

Call to Order.

Election of Officers.

Welcome to the Association.
HIS HONOR, THOMAS N. HART, Mayor of the City of Boston.

President's Address.
D. M. THOMPSON, Providence, R. I.

Report of the Secretary and Treasurer.

Waste in Cotton Mills.
EDWARD W. THOMAS, Lowell, Mass.

Latin American Trade in Cotton Fabrics.
WILLIAM WHITTAM, JR., Woonsocket, R. I.

Southern Cotton Manufacturing.
M. F. FOSTER, Milford, N. H.

TOPICAL QUESTIONS.*

119. In which class of machinery, as at present running, is it desirable to improve the most to obtain a minimum cost in manufacturing?

120. English practice has been in the direction of separating the business of spinning from that of weaving. What are the advantages of this separation? Is there any such tendency discernible in American practice at the present time?

Second Session, Wednesday, April 25, 1900, at 2 P. M.

A Critical Moment in the History of Export Trade in Cotton Manufactures.
DR. WILLIAM P. WILSON, Philadelphia, Pa.

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*Topical questions will be called up for discussion as time may permit at any session.

Belting: from Hide to Pulleys.

J. H. BURGHARDT, Boston, Mass.

Lighting Buildings by Refracted Daylight through Luxfer Prisms.

GEORGE K. MALTBY, Boston, Mass.

Warming and Ventilation of Mills.

PROF. S. HOMER WOODBRIDGE, Boston, Mass.

TOPICAL QUESTIONS.

121. What can be offered on the subject of the influence of moisture in the air affecting the strength of yarn?

122. What is the best temperature and humidity for good spinning on fine counts?

123. What is the best way to prevent double yarn on spinning frames where double boss rolls are used?

124. What is the best covering for the top rolls used on frames and mules that are to spin various numbers?

125 What is the best taper or length of wind for mule cops on number 37 filling?

126. Is it practical to spin numbers finer than 65s on larger rings than 1½ with spindle running 9,000 revolutions?

Third Session, Thursday, April 26, 1900, at 10 A. M.

Address.

HIS HONOR, JOHN L. BATES,
Lieutenant Governor of the Commonwealth of Massachusetts.

Systems of Payment on Mules.

JOHN B. CUDLIP, Marysville, N. B.

Methods of Cost Finding in Cotton Mills. (Second paper.)

WILLIAM G. NICHOLS, Chester, S. C.

Application of Mechanical Draft to Stationary Boilers.

WALTER B. SNOW, Boston, Mass.

The Height and Area Required for Chimney Draft.

H. G. BRINCKERHOFF, Boston, Mass.

TOPICAL QUESTIONS.

127. What is the maximum length to put No. 100s on bobbin?

128. How far is it practicable to substitute frames for mules in spinning filling?

129. What means have been found useful in diminishing the number of oil stains?

130. What steam pressure should be carried on slashers running on colored work, and what is the best means of returning to boilers the condensation from slashers?

131. What is the quantity of steam properly required for slashers and the best means of applying the same?

132. What is the best method of utilizing the waste products of a mill?

Election of Members.

Ring Spinning.

ALFRED E. ADAMS, Whitinsville, Mass.

Fourth Session, Thursday, April 26, 1900, at 2 P. M.

The Harriman Automatic Loom.

HENRY I. HARRIMAN, Hyde Park, Mass.

Cotton Mixing.

FRANK M. MESSENGER, No. Grosvenor Dale, Conn.

The Value of a Horse Power.

SAMUEL WEBBER, Charlestown, N. H.

TOPICAL QUESTIONS.

133. What is the best method of treating belts and their proper use?

134. Is it advisable to warm picker rooms with air drawn from the main mill?

135. Are automatic heat regulators an advantage both in economy and comfort?

136. What is the best method of cleaning mill windows?

138. What is the best method of introducing kerosene oil into boilers, and what have been the results from its use?

139. Do water tube boilers contain advantages for steam plants in mills?

140. Do separators remove enough of the oil from condensed steam to prevent all injury to the boilers?

The telephone booths in the corridor are placed by the New England Telephone & Telegraph Co. for the free use of the members for Boston

and vicinity during the day, and before 10.00 A. M. and after 4.00 P. M. free telephone service over the states of Maine, New Hampshire, Vermont and Massachusetts. At these booths the American Telephone and Telegraph Co. give free long distance service to members beyond this territory before 10.00 A. M. and after 6.00 P. M. In this, as in all the other privileges of the Association, candidates for membership will receive the same privileges as the members.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

The cotton bolls are sent to members and guests with the compliments of the American Cotton Company.

The records of the last meeting were read by the Secretary and on motion duly seconded were accepted.

The SECRETARY. It is my duty to inform the Association that at the close of this meeting there will expire by limitation the terms of office of the President, the two Vice-Presidents and two members of the Board of Directors.

Mr. STEPHEN A. KNIGHT. Mr. President, I move that a nominating committee of five be appointed by the chair.

The motion, being duly seconded, was put to vote and carried, and the President appointed as such committee Messrs. STEPHEN A. KNIGHT, S. S. SPENCER, GEORGE W. WEEKS, FRANK M. MESSENGER and HAVEN C. PERHAM.

The PRESIDENT. Gentlemen, this convention marks the 68th meeting of the New England Cotton Manufacturers' Association. When considered in connection with the vast interests which you represent it is suggestive of a power and influence which reaches far beyond the sphere of your individual vocations. The pro-

motion and advancement of the cotton textile interests is a contribution of great value to all others and to the commerce of the nation.

This Association has just passed its third of a century mark — a period indicative of almost historical interest — it suggests the thought that Boston is *your* headquarters, your home and the commercial home of the fathers and founders of the Association.

We all have, without regard to the place of our birth, a feeling of interest, in fact a warm spot in our heart for Boston. Its liberal contributions and great achievements within every sphere of human activity are without parallel in their influence upon American citizenship from the Colonial period until the present time. Its history of progressive development is a subject worthy of the most careful study. Within the radius of her commercial, industrial and cosmopolitan influence have been trained, men of broad minds and of liberal public spirit, whose works constitute monuments of enduring fame.

From among their number one comes to us this morning whose presence upon this occasion we regard as a distinguished honor. He is a gentleman who for many years has been closely identified with the commercial and manufacturing interests of this great eastern metropolis.

I have, therefore, great pleasure in presenting to you His Honor, THOMAS N. HART, Mayor of Boston, who proposes to welcome you to the hospitalities of this beautiful city, the capital of the Commonwealth of Massachusetts. [Applause.]

Hon. THOMAS N. HART. Mr. President and gentlemen, it is my pleasant duty this morning to come and welcome to Boston and to the state of Massachusetts, the New England Cotton Manufacturers' Association. We are glad to do it for the capital of Massachusetts and, we believe, for the capital of New England, where the great manufacturing interests center. We are glad that you have come here for your deliberations and hope that you will have an enjoyable good time. Anything that the city of Boston can do to advance the interests of this convention

through the Mayor, we shall be glad to have your committees ask for. If there is anything particular that you have not got, if you will suggest it to the Mayor, who is here present now, he will tell you this instant whether you can have it or not. [Laughter.]

Yesterday morning I welcomed the National Convention of Manufacturers, and shall be glad to see you all at the dinner tomorrow night, where we shall welcome the President's cabinet and other people representing different associations. I am not here to take up any of your time, but in the most cordial way welcome you to Boston. [Applause.]

PRESIDENT'S ADDRESS.

D. M. THOMPSON, Providence, R. I.

GENTLEMEN: The pleasure of greeting you upon this occasion, as President of your Association, elected to fill the vacancy for the unexpired term of my lamented predecessor, is tinged with a feeling of sorrow for the loss of one whom we all so much honored and esteemed.

FREDERICK E. CLARKE was a man of sterling worth and great nobility of character. He possessed a charming disposition, and his personal character was an assurance of good cheer upon all occasions. All who have had the pleasure of his acquaintance were impressed with his strong personality. He was a natural leader, and his associations during life embraced a wide range of experience and useful work. His careful, conservative judgment, united with a vigorous and determined energy in the pursuit of objects he had approved, inspired a more than usual confidence. His untimely death has cast a shadow of deep gloom and sorrow over the city of Lawrence, where he had lived since early boyhood and was widely known and honored as one of its most noted citizens. To his family and wide circle of intimate friends it is a sad bereavement, — an irreparable loss.

In the presence of these conditions, it is proper to remark that we regard the Presidency of this Association as a position of distinguished honor. It is the evidence and expression of a confidence and esteem for which the recipient should feel a just pride and gratitude. Therefore, it must ever be a pleasant memory to the family and friends of our late President and also

to the members of this Association, that he was thus recognized and honored during his life.

In accepting for myself the honors and responsibilities of this position, I have expressed to your Board of Government my sincere thanks and appreciation of their confidence, and I reaffirm the same with much pleasure in your presence and to all the members of the Association here present.

Although for a considerable period a member of the Association, and conscious of the great value of its work, I have taken, like many others, but little part in its transactions, a circumstance which I now very much regret, and more especially since I am unprepared on account of the limited time at my disposal to present for your consideration the important questions such as I conceive appropriate for this occasion.

In the brief time at my command, I have examined into the general affairs and condition of the Association. It has been a service in which I have found pleasure, as I have hastily reviewed the records of the past and contemplated the great possibilities of the future. The history and growth of this Association, as of many other institutions and spheres of useful work, suggest that the founders have builded more wisely than they knew or were conscious of at the time of its inception. I am impressed with the great opportunity now at hand and the greater necessities than have heretofore existed for the exercise of such influence as this Association can now command.

This is the sixty-eighth meeting of the Association since its organization thirty-four years since. It is pleasing to note its growth and the rapid increase in membership during the past few years. The evidence of this is apparent in the transactions, in the larger volumes which record the increasing number of valuable papers presented, and the deep interest evinced in the more general discussion of them and of topical questions.

The principle and purpose of the Association are well established. It has taken a strong position and posseses the confidence of a large circle who find pleasure in attendance upon its sessions. The interest shown by the large increase of associate

members is a recognition of which the Association may feel justly proud. The Board of Government, its Secretary, and all who have been associated in the management, are entitled to great credit for their earnest efforts and wise administration.

This is especially true when we consider the limited means at their command. While the Board of Government have the power, they have never as yet made an assessment upon members of more than $5.00 per annum. The admission, regular annual dues, and the income of nearly $1,000 from a number of advertisements, have barely sufficed for the work, to the present time. As the scope and importance of the work of the Association are steadily broadening, it is apparent that there ought to be provided such income as shall insure the greatest possible efficiency.

The business of the Association has been administered with strictest economy, and a comparison of its transactions and meetings with other similar organizations discloses a most efficient and systematic condition. The transactions are records of great value to all interested in the textile arts, yet there is no index of the whole. It is desirable that a catalogue of the full series of sixty-eight volumes should be issued at an early date. The volumes back of No. 48 were destroyed by fire. There is a fair supply, on hand, of volumes since then, except of No. 56, which is reduced to three copies, on account of a valuable report of a committee on the costs of weaving. This volume is not large, and it is hoped it can be printed during the ensuing year. Owing to the limited income, the transactions have been bound in pamphlet form, except a few volumes in cardboard covers. It is hoped that the income may justify the better binding in the future and afford the management the necessary means for the accomplishment of other work of great value to the Association.

I venture to suggest that you will give to this matter careful consideration, since it involves a question of almost vital interest, to the end that sufficient means may be provided to meet the steadily increasing expenses and to accomplish such further ob-

jects as you may approve. It has seemed to the Board of Government a matter worthy of your attention.

You will find many associations organized for similar work, whose annual dues are very much larger than is provided in the by-laws of this Association. When you reflect that under present conditions it is becoming known and recognized by large interests that the sphere of influence of this Association is rapidly extending, and its work has already become a factor of power, you will appreciate that there are responsibilities which must be met, and such as to justify your serious attention.

REPRESENTATIVE ASSEMBLIES.

The congregation in large assemblies of individuals, representative, through their intelligence and education, of the best type of our civilization, is always an impressive sight. I am, however, impressed with a feeling that an audience composed of individuals representative of distinctive departments in the useful occupations or subdivisions of labor, such as bankers, merchants, engineers, or manufacturers, is even a more impressive one, for the reason that I am conscious of a presence which represents all that is known in that particular branch of science, art, or industry. I know of no department of industry wherein there exists a necessity for such gatherings or where there is to be found a higher order of intelligence and skill than in the arts of textile manufacture and in the management of the vast interests represented by the members of this Association.

I have spent many years of labor in the various departments of this industry, yet, as I stand in your presence and look upon this assemblage, noting the sparkle and glitter of eyes beaming with an intelligence which signifies to me such a wonderful store of information and knowledge of the art, and conscious that collectively your experience is of incalculable value in every phase of the business which so deeply interests us all, I am profoundly impressed that our individual achievements are measureably limited and our experience is within comparatively narrow spheres.

IMPORTANCE OF THIS ASSOCIATION.

As I ponder upon and consider the trend of recent events and note the changing conditions of business methods, the necessities of a larger product, improved qualities and a steadily diminishing cost, conscious of the difficulties and obstructions which lie in our path, having also in view the developing tendency and movement towards concentration of interests, I am more than ever impressed with the importance of this Association and its possible influence in behalf of the cotton industry which can be made of incalculable value.

In this view, it is a matter of deep interest to all, and especially within the United States, who are engaged in the manufacture of cotton, whether in the production of yarns, the textile fabrics, or the finishing thereof, that they should have representation in the membership of this Association. I believe this to be a question of such interest as to justify the earnest effort of all members in its promotion, and a provision, by the Association, of such means as will enable the Board of Government to properly execute the measures you may devise.

There are many events of recent occurrence involving important questions of world wide interest. As a nation, a people or as individuals, we are impressed according to the point of view from which we look upon them or as we may fancy they affect our several interests. Yet, in the end, we shall probably be of one mind, for the forces which influence and will determine the result are in operation, and the conclusion, though disappointing for a time, will surely be right. This condition, though accepted as a fact, does not relieve personal responsibility, because all are contributory factors.

We may witness the course of one whose method, views or policy we may regret, yet it is not wasted; it has had its influence; strenuous and determined opposition may be wide of the truth and bereft of all honors, though its contributions may have proved of value, as in the economies of the forces and elements in nature there is nothing lost. The development of our civili-

zation has proceeded along these lines. Every important event in the world's history, but more especially during the past five centuries, has been a contributing factor to the results which we now witness. There are but few who will seriously question the results which are today established conditions of human life, or doubt the wisdom of that power which directs and shapes the destinies of man.

As a nation we have occasion to be justly proud. Its progress and development have been marvellous. The character of its people, its vast wealth and illimitable resources constitute a record in history which may rival the tales of Arabian Nights when read or comprehended by peoples and nationalities which, until recently, were without this knowledge. We have far more than we may realize, for which we should be devoutly thankful. Our lots have been cast in pleasant places and embrace conditions, comforts and luxuries of living which a century since would have been impossible to imagine. It is scarcely credible that our modern industrial development is comprised within the brief period of 136 years.

EARLY INFLUENCES.

The discoveries of the fifteenth century by distinguished philosophers and physicists established the science of astronomy and the celestial mechanics. The discoveries of the weight of the atmosphere, and the natural laws of gravitation, of chemistry and its founding as a science, secured the most marvelous results, both in medicine and the arts, by the use of the simple materials and elements in nature. These and the influence of the fine arts of painting and sculpture of Greece and especially of Florence in the fifteenth century, were of incalculable value and constituted the foundations upon which the grand superstruction of modern civilization has been erected. We pass over the intervening period of gradual development and enter upon the seventh decade of the eighteenth century, a period which must be forever memorable as the birth era of our modern industrial life.

To the textile industry must be accorded early honors. The

inventions which now appear so crude and simple, yet were such as enabled the spinning of yarns and the manufacture of fabrics by machinery. The improvements of the steam engine and the subsequent inventions which rendered its employment as a motor for the generation of power practicable, marked the *entre* into an era of such marvelous progress as to almost bewilder the mind in its contemplation. The genius of invention has passed the scope of ordinary knowledge, its almost infinite application to every condition and sphere of industrial activity and to every conceivable want or necessity of human life, whereby ten, a hundred, and even a thousand fold has been added to the former productions of human labor, is impossible to fully comprehend. The alarm and horror of the early times as to loss of occupations have long since ceased with the demonstrations that these marvelous facilities are steadily and surely absorbed and appropriated to the advancement of labor and its elevation to planes of greater comfort and to the acquisitions of pleasure and luxuries before unknown.

The closing year of the nineteenth century is a peculiarly appropriate time, and the present a fitting occasion, for brief reference to a few events and conditions in the past which indicate the course of industrial progress. Investigation will disclose a wonderful picture, a panoramic review of causes and their effects, and an exhibition of the steady and increasing effort of human nature. Its careful study is an inspiration. I will note but a few points suggestive of the spirit of the people, their methods and habit of concealment, customs which were so crystallized into their system and practice as to require a long period after the enactment of the patent laws for the removal. The artist, mechanic, or manufacturer who may have discovered something new was sure to conceal it from the world, generally preferring this method for the protection of his interests. He would exhibit his products, but permitted no person to witness his process or methods. Gradually but slowly, more enlightened and liberal views were developed as a result of and co-incident with a broadening spirit.

Toward the close of the eighteenth century local exhibitions were inaugurated. Their value was promptly recognized. The impulse thus given met with quick response in the formation of County and Borough Associations. They were taken up by the people of France, greatly assisted and encouraged by the first Consul. The spirit extended through western Europe, until public sentiment, enlisting government support and co-operation, they became national. In 1849, liberal leaders in France proposed an international exhibition, but it was promply suppressed by the influence of a majority of the Chambers of Commerce throughout the empire insisting that such a proposition must have emanated from the enemies of French industry. The seed, however, had been planted; though of slow growth it was sure to develop; a harvest was even then in sight. Influences, such as the Society of Arts in London, were of incalculable value and resulted in the first international exhibition held in London at the Crystal Palace, in 1851.

Viewed from the point of the then existing conditions, it was a marvelous success, a wonder of the age. This incident marked the second epoch of industrial development. As compared with subsequent expositions, it was limited, and in a measure primitive; yet it was a grand modern incubator; the shell and crust of pessimism and the prejudices of the past were broken, and there emerged a vital force, a living spirit, which spread its wings in the clear atmosphere of a brilliant sky. Its course has since been steadily onward and upward, reaching out into the utmost parts of the earth, and destined in the near future to lift from barbarism a thousand millions of people into the blessings of a civilization we now enjoy. The varied evolutions of this development must impress all who will give it close attention that there are responsibilities which we are bound to respect.

MARVELOUS DEVELOPMENT.

In further illustration of the purpose I have in view, I invite your consideration of the work of GEORGE STEPHENSON in his perfection of the traveling engine or locomotive started by

TROVETHICK. It represents a service rendered to mankind scarcely less important than that by WATTS. On July 25, 1814, fifty years after the invention by HARGRAVE of the spinning jenny of eight spindles, STEPHENSON'S first engine, "My Lord," built for a coal tramway, was started and proved successful upon its first trial.

The Stockton and Darlington Railway was projected for the transportation of merchandise by the use of horses. STEPHENSON was subsequently employed in its building. It was the first railway over which merchandise was ever transported by steam power. It opened for operation September 27, 1825. The engine, "Rocket," made a trial speed of twenty-nine miles per hour, and with thirty-six carriages and a load of ninety tons, a speed of about six miles per hour. This led to STEPHENSON'S employment as engineer to build the Liverpool and Manchester Railroad of thirty-one and one-half miles, which was opened for the transportation of merchandise in 1829 and shortly after for public travel.

Prior to this period, the transportation was through canals, of which there were three. Owing to the crowded traffic it required usually a month for the transportation of cotton from the seaport at Liverpool; the water course of but fifty miles required thirty-six hours in actual transit, and a cost for general merchandise of 18s., or $4.50, per ton. The railway transportation reduced rates from 5d. to 1-5 of a penny per mile per ton. The price of coal at Darlington was reduced from 18s. to 8s. 6d. per ton.

In the short period of fifty-seven years after the inauguration of the first railway, the Manchester and Liverpool Railroad formed part of a system owned and operated by one company representing a capital of £100,000,000. Can you realize the import of all this, or that it is but seventy-one years to the present time?

What do you think would have been the judgment of the people present upon that distant occasion, if a speaker had attempted to describe or picture to them the conditions which would obtain in the closing year of the nineteenth century?

Railroads.

In this brief period the world has acquired 444,200 miles of railroads, of which Europe has 36½ per cent., Africa 2 per cent., Asia 6 per cent., Australia 3 per cent. and the United States 52½ per cent. of the mileage, or 184,194 miles and 60,340 miles of side track. Its equipment comprises 36,746 locomotives and a total of 1,318,700 cars, representing a capital stock and bonded debt of $11,217,158,452.

Since 1825 there have been built in the United States 34 commercial canals at a cost of $194,105,000. (The Suez Canal cost $102,750,000.)

The world has today 323 lines of submarine cables comprising 151,067 nautical miles.

Telegraph.

The Western Union Telegraph Company have 189,856 miles of poles and cables, and 904,633 miles of wire and transmitted in 1899, 61,398,157 messages at an average cost of 25 1/10 cents, being less than one-fourth the cost in 1865.

The Postal Telegraph furnish no records.

Telephones.

The American Bell Telephone Company have a total of 1,518,609 miles of wire, of which there are 489,250 miles of wire underground.

There are 1,580,101 instruments and a daily average of 5,306,687 exchange messages.

The Company have a capital stock of $25,886,300.

The Long Distance have 150,380 miles of wire.

Germany with a population of 52,279,901 has 173,981 telephone stations.

France with a population of 38,518,975 has 45,000 telephone stations.

Great Britain with a population of 37,738,000 has 103,275 telephone stations.

United States with a population of 78,500,000 has 632,946 telephone stations. A number equal to the whole of Continental Europe with its population of about 475,000,000.

Electrical Development.

The capital invested in electrical industries is $3,260,000,000. It is estimated that a capital of $1,000,000,000 is invested in electric lighting plants.

The are 950 electric railroads with an investment of $1,700,000,000.

Electric power transmission has now become generally recognized. Its successful operation is well established, as in the case of Niagara Falls, and other points where power is transmitted over long distances. This will lead to the development of very large water powers which would be otherwise unavailable because of location and physical conditions.

Considerable interest is now manifest in its application to textile mill equipment. The system is especially applicable in the reorganization of power plants having several units, and for purposes of concentration and better distribution.

The first application of this was a single phase motor of fifty horse power installed in 1890. At the present time there are several plants in operation comprising over 16,000 horse power, and nearly 30,000 horse power is under contract and in process of construction.

The progress of this department of industry is marvelous, and when we recall that it is all comprised in a period of but little over twenty years it is almost overwhelming to contemplate its probable future.

Imports and Exports.

The imports into the United States for year ending June 30, 1899, were $697,148,489.

The exports from the United States for year ending June 30, 1899, were $1,203,931,222, of which amount $338,000,000 were manufactured products.

Savings Banks — United States.

Exhibit deposits, in 1899, of	$2,230,366.93
Number of depositors,	5,687,818
Showing an average deposit of nearly $400.	

The above is exclusive of commercial banks. It is a wonderful exhibition and deserving of careful consideration, in connection with very important questions now engaging the public attention.

Europe.

Saving deposits in all European countries,	$4,593,940,450
Number of depositors,	48,687,818

Average of deposits, $94.35; or less than one-fourth of that of the United States.

LESSONS OF THE PAST.

These citations are a very few from the vast store of information relating to the production of labor, but will suffice to call our attention to questions of importance which can not be overestimated. Occasionally we meet persons who seem indifferent or unable to appreciate the forces which have wrought this marvelous progress. They will generally look closely to their own affairs, feeling a sort of confidence that all will be well, and that the general results are shaped and predetermined by the natural laws of trade. Such a view is, in many respects an error. We cannot reap that which we have not sown. Thistles and underbrush may thrive without our aid, but a harvest of valuable cereals requires that the grounds shall be properly prepared to receive the seed. In the operation of mills, we know that more is required than simply putting the machinery into motion. Primal causes are coincident with and find expression in human effort. The results are determined by the exercise of intelligence and skill, guided by experience. This general principle is alike applicable to the collective affairs of communities

or a nation, as to the interests of the individual, since all are interdependent.

The events of the past are matters of indisputable record, and their results may be accepted as safe guides for the future. In the light of such an experience, it would seem as if there can be little doubt in the selection of our course. Unless, however, we are constantly on the alert, there is grave danger that we may err in respect to our judgment, and, as those who have preceded us, move more slowly than we ought. "Eternal vigilance" is the watchword of the hour. It is not alone the price of liberty: It is the determining factor in all business operations. The marvelous achievement of the past is an inspiration for the future, and justifies the largest measure of effort. If properly directed, the results aimed at are sure of attainment, and the compensation will reward the highest ambition. Among the problems we are called upon to consider in our business affairs, there are thoroughly practicable propositions simple in their conception but oftentimes difficult in their solution or execution.

Conditions confront us, at the present time, of such grave import as to justify the exercise of every means in our power, to the end that many weak points in our industrial systems may be strengthened and improved, and insure every possible measure of permanence and safety for the future. In the attainment of many of these objects, it is indispensable that there shall be concentration of effort. There are factors involved which lie beyond the power of individual labor or experience. Their solution or advancement into planes of greater value to all concerned, demands a union of interest. This principle is now in progress; results are already secured which justify the proposition that "In union there is strength". Analyzed, and specifically expressed, it implies a power and force ten-fold greater than is possible to individual effort on the basis of equal numbers. The ties which bind men together through mutual compacts designed for the protection of life and property, and exercised through the functions of government, insure a strength of almost inconceivable power: the reverse means anarchy and ruin.

BUSINESS CONDITIONS.

The present conditions of business are such as to justify congratulations. Its activities are a welcome sight to a people who have suffered and struggled for existence through a long period of financial disaster, of such exceptional severity as to imperil vested interests and long established industries. The records of human suffering, and the wreck of fortunes; the suspension of useful occupations and the curtailment of production; the exhaustion of the resources and savings of labor, and its non-employment, are the memories of a past which we would fain forget. On the contrary, we shall for a long time remember it as a period during which vital and severe conditions, rather than theories, confronted us. From a condition of prosperity in 1892, when both labor and capital were profitably employed, we were, by an Act of Congress repealing tariff laws, thrust into the depths of a dark chasm of despair and industrial ruin. The losses, including suspended production, amounted to thousands of millions of dollars. If it shall prove that we are able to avail of the experiences which necessity then imposed, we shall, in the future, re-coup, as a people, much of the sacrifice then endured. It is gratifying to note that there are evidences of such a spirit.

It is possible, that at some period of the future, we may look upon the recent misfortunes with more of charity toward their projectors than has been possible in the past; since we must recognize that the necessities of the times have compelled the adoption of methods and business policies which give promise of great benefit in the future. It was under such conditions of dire necessity, that the public spirit which we now witness came into being as a vital living force. Its mission is one of incomparable value, and the logical conclusion of its achievement will mark the close of the nineteenth century as an era long to be remembered as the third epoch in the history of modern industrial development, in regard to which the honors will be distinctively American. Herein is the manifestation of a spirit and

purpose which gives promise of a future for American interests such as we have not known in the past. It suggests to the genius of American invention and enterprise, an opportunity for which it has long waited; and its utilization will prove of deepest interest to American labor and American capital. It is in behalf of this liberal thought and broad public spirit — a potential force of resistless power — that I plead for your support.

ILLUSTRATIONS OF ORGANIZATION.

In this connection, I suggest the "Philadelphia Commercial Museum" as a fitting illustration of the value of organization. Conceived during the Columbian Exposition, it is but six years since its founding. Many of you are familiar with its operation. Its achievements to the present time are of incalculable value. Its collections of samples, of raw materials and the products of industry, from all parts of the world, constitute an almost priceless treasure. The information already acquired, its collation and the channels established for its distribution, as such as one unacquainted with its operation can scarcely conceive. Its value is well established and it is destined to become a storehouse of knowledge and a repository of information such as the world has not yet possessed. Independent of all its work to the present time, it has rendered a service of immeasurable value in its influence upon the minds of men who are indispensable in the promotion and accomplishment of important operations.

Another example worthy of notice, and of the highest appreciation is the "National Association of Manufacturers". This Association is now holding its Fifth Annual Convention, and within the same building in which we are now in session. It has a membership of nearly two thousand representative men who are leaders in widely diversified industries. The value of its services already rendered to American industry and its commercial interests are incomputable. Its influence is a vast and potent force in shaping commercial policies and in the promotion of a foreign trade. The course it is pursuing and the deep

interest of its members are an assurance of marvelous achievement in the future.

When you consider that during the present week, there are other important associations, viz.: The Woolen Association of Manufacturers, the Shoe and Leather Association, and the Paper and Pulp Association, making in all five organizations now holding their annual conventions in the city of Boston, it is suggestive of a condition which promises wonderful advances.

IMPORTANCE OF EXPORT TRADE.

I am so deeply impressed with the manufacturing and trade conditions of Americans especially during the last decade, that I am unable to refrain from the most urgent presentation. As I have before and repeatedly remarked, I am convinced, beyond the question of a doubt, that we are upon the threshold of a possible revolution of former business methods. I feel assured that almost within our grasp are opportunities such as but a few years since were scarcely believed possible. The marvelous advances in many leading American industries justify the desire and early expectation of a large export of manufactured products. The facilities for American productions have advanced so rapidly as to render the acquisition of foreign markets a vital necessity. Heretofore a general feeling existed that such a condition was impossible except through a removal of tariffs, and the placing of American labor upon the level of European conditions. We have had sufficient of that experience. We believe, as ever before, in the protection of American labor, and in such wise adjustment of tariff as will insure the protection of all industries so long, and to such extent, as protection may be necessary. Our present conditions have been created only through the system adopted of protection. There are many of our products which can be exported subject to proper influence that will insure not only permanent employment of present labor, but which will permit of large extension of present manufacturing plants.

While this Association must be restricted in its specific oper-

ations to the cotton manufacturing industry, yet its influence can easily be made a factor of great value in the promotion of general interests, such as that which in turn we ourselves receive from others. Hence, the justification of co-operation. Owing to our past experience, a feeling exists that over-production is an eminent peril, a source of constant danger. This fear we may accept as our justification, and it is a sufficient reason to encourage every effort within the power of all who have interests at stake, to procure the most favorable conditions for the export of cotton manufactures at the earliest possible time. The ends justify the means and both are within your reach.

Value of the textile products of the United States in 1890 was	$683,064,000
The woolen industry represented,	19 per cent.
" worsted " "	10 "
" silk " "	12 "
" carpet " "	7 "
" hosiery and knitting nearly,	10 "
" cotton industry represented,	42 "

COTTON CROP OF THE UNITED STATES.

Cotton crop in 1829,	870,415 bales.
" 1899,	11,235,383
Cotton consumption in 1886-87,	1,938,000
" 1898-99,	3,553,000
An increase of 66 per cent.	

The cotton spindles in the world, about,	105,000,000.
" " of Great Britain, nearly,	44 per cent.
" " " United States, about,	19 "
" " " the Continent,	32 "
" " " the East Indies,	5 "

In 1898 there were 19,410,554 cotton spindles and 453,281 looms in the United States.

For the year ending June 30, 1899, the value of the world's export trade in manufactures of cotton was $500,618,412, distributed as follows:

From the United States,	$23,566,914
" England,	328,325,157
" Germany,	53,637,776
" France,	32,081,095
" Austria-Hungary,	4,142,910
" Italy,	10,747,854
" Russia (estimated),	1,500,000
" Switzerland, "	25,000,000
" Belgium,	5,440,746
" Japan,	16,215,960

While the exhibit of the United States is not flattering, it emphasizes the importance of the plans suggested as means of relief.

The total value of American exports of domestic manufactures for the same period,	$338,675,558
The farm value of the American Cotton Crop,	260,223,000
The total value of American exports of domestic merchandise,	1,203,931,222

The value of American manufactures of Cotton.

1895. Total exports,	13,789,810
1895. Exports to China,	1,723,394
1899. " "	9,844,563
Cotton goods imported into Shanghai in 1898 was,	38,500,000
From the United States,	5,203,427
While Great Britain secured,	23,500,000

EXHIBIT OF THE DISTRIBUTION OF THE EXPORT OF COTTON MANUFACTURES FROM THE UNITED STATES IN 1899.

Germany,	$232,411
All other Europe,	359,601
Central America States,	737,259
British West Indies,	465,540
Hayti,	509,597
Brazil,	587,202
Columbia,	439,136
Venezuela,	601,609

China,	$9,844,565
Turkey in Asia,	130,532
Hawaiian Islands,	464,925
Africa,	516,193
United Kingdom,	892,351
British North America,	2,759,164
Mexico,	883,531
Cuba and Porto Rico,	757,739
Other West Indies,	290,385
Chili,	499,318
Peru,	132,625
Other South America,	494,079
British East Indies,	268,791
British Australasia,	414,164
Other Asia and Oceanica,	1,217,107
All other countries,	109,092
Total,	$23,566,914

The above is a very brief statement of a few important features of cotton manufactured products, and their distribution in export. They are suggestive of conditions requiring the serious attention of Americans. There is much other information which indicates the promise of a valuable trade with the Hawaiian Islands, the Philippines, and Porto Rico. When we consider the changed conditions which have obtained during the past two years, there is occasion for universal rejoicing. The present policy of the general government affords means for important and essential service in aid of an export trade, which was formerly wanting, and for a time seemed impossible to obtain. The question also involves a consideration of the important recent events in our National affairs, and the issues are of the deepest interest to the American people.

AMERICA A WORLD POWER.

Time and space forbid me more than a brief allusion, and only as it suggests relevant matter suited to the subject I have in mind. The Hispano-American war was not of American origin.

Its horrors and calamities cannot be charged to American influence, or to an imperialistic tendency and desire of our people for extension. All influence within the power of our government was exercised with the desire to avert the sad disaster. Forced upon us through circumstances beyond our control, and under conditions which touched our National honor, the issue was accepted. The struggle was incisive and brief; the significance of its results cannot be more than a brief time misunderstood. National honor has been vindicated; American interests and the character of the American people, their versatility and marvelous resources, which constitute their great power, have become a factor in the world's affairs, and their exercise will contribute to the advancement of civilization. Millions of people now in semi-barbarism will yet hail this event as a trumpet call for freedom,—a liberation from the bondage of ignorance and superstition,—and generations yet unborn will in the future give praise and thanks to the God of their fathers for His interposition of American power in their behalf.

I believe that the time is not far in the future, when all Americans, independent of party considerations, will recognize the incalculable benefits which have been secured in this recent disposition, and will acknowledge the guiding influence, wisdom and power of that Divine Providence which directs the destinies of nations.

Our national growth and industrial development have moved forward so steadily, to the present time, crystallizing their forces into the very life of all useful occupations, that it is not strange that we accept the results in a sort of passive and unsentimental spirit. It is only when we permit or compel our minds a brief rest, and in a reflective mood turn backward and look into the records of the past, recognizing that each and every event and evolution have been contributing forces, that we are able to fairly and without prejudice judge of the present, or wisely speculate as to the future.

As I review the past, it seems to me almost incredible, that it is only since 1792 that SAMUEL SLATER built the first American

cotton mill, at Pawtucket, R. I. How simple are the problems of engineering, equipment and operation today, as compared with SLATER'S time, when every scrap of information was concealed, and such embargoes and restrictions imposed as to make it a crime punishable with severe penalty for any one who should attempt to supply plans, or in any way furnish information to foreign interests touching the art of cotton spinning.

LABOR CONDITIONS.

The history of industrial progress records no greater achievements than are to be found within the sphere of your vocations. You may there witness nearly every phase in the social life of the laboring class. A higher average of intelligence and skill, or more comfortable conditions of living and its attendant pleasures are rarely found than among the artisans and employes engaged in the manufacture of the textile fabrics.

The deposits in our savings banks exhibit evidence of their frugality and thrift. A general condition of common interest is found in all of the useful occupations. A comparison of the present with earlier times affords convincing testimony that relative conditions of living are practically unchanged, the labors of all are subject to one general law and principle in the distribution of wealth, and that all classes are advanced to higher planes. There are, however, mischievous and disturbing influences in operation which point to much serious trouble in the future. I believe this is a question of grave import to all interests. It should be given early and careful attention.

The members of this Association have had invaluable experience, and I know of no subject more worthy of your attention. The financial interests you represent have very much at stake and are entitled to every protection which can be devised. The outside demands for the reduction of the hours of labor from ten to eight is unreasonable and in utter disregard of economic considerations. There can be no question that the hours of labor will in the future be reduced as a natural result of the facilities for production, but changes should be gradual so as to avoid serious disturbance, the sure penalty of error.

ASSOCIATION DISCUSSIONS.

I trust that you will not understand me as suggesting in the slightest degree an abandonment of your past practice or policy in the treatment of technical questions. I recognize their importance and hope to witness even greater interest. In this connection, I beg to suggest and urge a more general participation in discussions than heretofore. If we would attain the benefits possible to the Association, all must contribute some measure of their knowledge and experience. I am as well aware as any of you of the difficulties of speaking in public, and with what ease one's thoughts take wings and fly away. The only possible remedy for this, that I can suggest, is that we must all become better acquainted with each other and feel that each has the other's confidence. There is, in this membership, as I have before remarked, a store or reservoir of knowledge which is invaluable. It is but just and fair to all that it shall, in some way, become available for useful work.

I have, possibly, presumed too much upon the privileges of position and occasion; if so, my only defense is an earnest desire to contribute some thought, feeling, or suggestion which your intelligence will turn to practical account. I have chosen to deal with what, in the main, I conceive to be the fundamental and governing principles which underlie all human effort, rather than to discuss at this time concrete questions in the technics of our Art.

SECTIONAL INTERESTS.

There is one which I will invite you to consider at your convenience. It is the question of Northern and Southern interests engaged in the manufacture of cotton products. What are their present relative conditions? To what extent is the Southern a menacing factor to Northern interests? If such difference exists as by some supposed, then is there a remedy which can be applied without injury or prejudice to either, which shall establish an equilibrium?

We have a large representation in our Association of members

who represent Southern interests. I have the pleasure of a considerable acquaintance among them, and, I trust, their confidence to such extent as to relieve me from any feeling, on their part, that I am presenting a question in a spirit of rivalry, or which shall, by any means, induce that spirit. On the contrary, I believe it is of the highest interests to both sections that this question shall receive calm and deliberate consideration, to the end that a true knowledge of the condition may be secured, in the interest of all concerned.

During the period of recent depression, it became a question of grave concern to Northern manufacturers. Southern mills were selling their products at prices which the Northern mills could not meet without loss. This experience naturally produced a very depressing effect, which has lingered even since the change of commercial conditions. It is a matter of general knowledge that preparations and work are now in hand which will add, during another year, nearly 2,000,000 of spindles to Southern production, while, in the North, but little is being done other than in the increase of product which will result from renewals of machinery. There is a fear, on the part of some persons, that the present policy of non-extension may be continued for an indefinite time. If the present movements upon both sides are long continued, then both the conditions and results are for a time as effective as if the claims of many Southern interests, as to ultimate control, were really true. This judgment is, I believe, in error.

The *natural* advantage possessed by Southern over Northern mills is by no means a menacing or a seriously disturbing factor, as it does not exceed 4 per cent. The total difference, upon the basis of equal conditions of plant, will vary from 15 to even 20 per cent. Now, it must be apparent that if the natural advantage does not exceed 4 per cent. then all other differences must be abnormal. They are due to the less cost of labor, and the larger number of hours of running time. This condition cannot long endure, and will gradually disappear with the exhaustion of labor, improving conditions of operatives and reduc-

tion of running time. It is a question of interest to both sections that the truth shall be known, because there are other interests involved, which are vital and require co-operation.

The conditions I have at first indicated as likely to obtain in the near future, are such as will justify a very much larger increase in the number of spindles and production than is generally believed. It is for the interests of all sections that the distribution of this growth shall be made upon just and equitable lines. This will give to the South the coarse goods and low grade fabrics of medium counts, and to the North the high grade fabrics of medium counts and the fine yarns and fabrics. I think this indicates a reasonable condition and an equitable division, a prediction that I made twenty-two years ago and before either section had given the matter more than general attention.

SUGGESTIVE.

When you reflect upon the marvelous progress in all lines of useful work, as indicated by the very limited statistics quoted, we are astounded by its grandeur and magnitude. What would have been the general opinion of one who had twenty-five years since, predicted that Great Britain, in 1900, would place a single order for 2,000,000 tons of coal, with one of the Alabama coal mines to deliver f. o. b. ship, at New Orleans, at a minimum cost of $1.50 per ton? Equally impressive would have been the prediction that at this period the United States would lead the world in the production of pig, refined iron and steel. These are suggestive of many other achievements.

In view of the overwhelming evidence which surrounds us on every side, we must accept the proposition that products of invention and improvement are now multiplying more rapidly than at any previous stage in the world's history.

CONCLUSION.

Thus the spheres of human activities are steadily multiplying. Forces of nature are responding to man's discoveries, as, in a

steady procession, they move forward to the accomplishment of some grand purpose which until recently, was unknown. Achievements in science, which seem as the visions of a dream, beckon us onward, inspiring a spirit of ambition and ceaseless effort in further investigation. We are overwhelmed in wonder and amazement, as we try to forecast the possibilities of the future. Speculation and experiment have passed to a point where experience has demonstrated the possibility of constantly changing conditions. Improvements, and the advance toward higher planes of social life are as wonderful, in their ever changing forms, as the marvelous imagery of the kaleidoscope. Each step forward simply discloses to our vision the illimitable and unexplored space, which neither science, art, nor any instrument of man's discovery has yet been able to fathom. Benefactions such as have been bequeathed to humanity by distinguished philosophers, physicists, and the notable inventors of more recent times, will pass on as a heritage for all of the generations that come after—an inspiration which will thrill the hearts and quicken the nobler impulses of human life, uniting the best thoughts and activities for the advancement of the public weal and the establishment of peaceful relations and good-will among men.

The SECRETARY. Mr. President, before we go on with the meeting, I have a notice to give relative to the banquet given by the citizens of Boston to the National Association of Manufacturers tomorrow evening at the Mechanics' Building. I would say that the seats in the gallery are to be reserved for the ladies and their escorts or those who would be an escort if circumstances permitted, and I understand from the committee that a number of the members of this Association have received some of these tickets and a number of them have bought dinner tickets. These tickets, I would say, are divided into two classes. That is, the reserved seats were given to purchasers of dinner tickets and the rear four rows of seats in the balcony are for the holders of admission tickets merely, not reserved, and at quarter of eight the ushers will let people go forward into any vacant seats which have been reserved up to that time. Now if any of the gentlemen here have not received those tickets, I have some to be given away, only we want to be sure that they will be used. If any gentlemen will put up their hands who wish to have balcony tickets, I will be glad to supply them. It may not seem strict hospitality to invite a person to look on at a banquet, but there will be fine music during the dinner, and speeches from some of the ablest men in this country afterwards.

[At this point President THEODORE C. SEARCH of the National Association of Manufacturers entered the hall escorted by Mr. ARTHUR H. LOWE.]

The PRESIDENT. Members of the New England Cotton Manufacturers' Association; I have much pride in announcing to you that the gentleman who has this moment honored us with his presence is one whom you will all be delighted to meet. Many of you are probabiy acquainted with him, and I trust that all of you may come to know him as he deserves on account of the invaluable services he has rendered to manufacturing and commercial interests throughout the country. The work in which he is engaged together with the powerful Association of

which he is so important a part is laid upon lines differing materially from ours and embraces a broader sphere of action which combines all useful occupations and is therefore kindred to our own and all other manufacturing interests. It is also in a most important sense commercial. I have great pleasure in presenting to you Mr. THEODORE C. SEARCH, President of the National Association of Manufacturers.

Mr. THEODORE C. SEARCH. Mr. President and Gentlemen of the New England Cotton Manufacturers' Association, I need not say that it gives me great pleasure to be with you this morning, although it is a very unexpected call. I was just telling our Association below how characteristically New England this call was; in other words, it came in the proposition of a trade, that we should have your President and our President should come up here. But it struck me at the time that we were going to be the gainers thereby, which is something ususual for people outside of New England to be [Laughter], inasmuch as we would get a good man for a very indifferent one. But I believe in the exchange of amenities of this kind whenever it is possible. I do not think when we consider matters of this kind that we should be selfish. The selfish proposition, that which appeals particularly to our own business or ourselves alone, is not a broad gauge view for a man to take, and it is not one that makes for the most good under the conditions under which we are working today the world over. It is the broad view, the broad work, the liberal man, the liberal principle, based on conservative method, that wins. So I come before you, gentlemen, feeling that I am almost one of you. Although the lines on which I have been operating during the whole of my life have been parallel to you, they have not been allied. You have been engaged in cotton manufacturing; I have been engaged during the whole of my life in woolen manufacturing. You have had the best end of it, we have had the worst. But today things look brighter for us and brighter for you.

I remember a few years ago I was called upon to make a few

remarks at a dinner given by your Arkwright Club at a time when skies were lowering, when trade was very discouraging and none of us knew exactly what to do. I know I advocated very strongly at that time that the proper thing for the cotton manufacturers to do was to look after the export business. I know at that time there were a very few beginners among the cotton manufacturers on this line, and it was a question then with you of policy, whether it could be made profitable or not. I think that the time that has elapsed since that and the work that has been done shows conclusively that the thought then in our minds was a wise one, and that the work that has been done since then has been done mainly because of our export trade.

You have been confronted with a very delicate condition of affairs in your business, in the relations that exist between the North and the South, between the opportunities for manufacturing there and the opportunities for manufacturing here, the cost of doing work in that locality and the cost of doing work in this locality. It is a question that I myself have not been able to examine into very carefully with any of your large cotton manufacturers, to know how you are getting along with that problem. But in conversation with some of your New England men whom I found largely interested in these Southern cotton mills, I have found one great and good feature, I think. I was told the other day by a man who was interested in several of the cotton mills of the South that at least three-fourths of the product of the cotton mills of the South were going out of the country; that is, of those in which he was interested. The statement rather surprised me, notwithstanding it is somewhat my business to keep on the track of such facts; it rather surprised me to learn that there was a group of mills which were so largely exporting their product. But when I learned it, it accounted to me quite satisfactorily for the great growth of the cotton industry in the South. And I have since learned of the enormous profits that are coming in to the cotton manufacturers of the South and have been coming for the last year or two years. This is all very gratifying, and it simply points out to

me one thing; that while the natural home of the cotton fibre is right here, while we are practically the cotton producers of the world, at the same time, we have within our own borders the ability to make the cotton goods for the world. [Applause.]

Unless I am misinformed and unless my judgment is wrong, I believe that the North and South combined can make the market for cotton goods in the world. I believe that the conditions of labor, and the market for your raw materials, and the growth of those raw materials so near the fields of consumption in the South is going to make your trade an invulnerable one, so far as its liability to be met and to be conquered by the conditions that exist anywhere else in the world is concerned. I believe that we can manufacture these goods, such goods as are now being manufactured in the South, more cheaply yard for yard than can be done anywhere else. I believe that the skill that the Northern manufacturers of cotton have is not to be surpassed by the skill of any other class of workmen anywhere in the world. So that I bring two conditions in my mind together — the ability to make the very finest products and the ability to make the very lowest class of products and the medium class of products at the very lowest price. And I think these conditions are bound to win the markets of the world, and I am here now to congratulate you, gentlemen, on what I believe to be a statement that is bound to be made good in the near future if it is not already true today — that the manufacturers of cotton in America are going to rule the world with regard to their products. I believe that cotton growing in America in going to increase and that we are going to raise the cotton for the world and manufacture it.

Now, in regard to the other conditions which prevail throughout our country, I have no word to say of any of them except words of gratification. You know how prosperity prevails throughout this land; I think you must all know the cause of that prosperity. Gentlemen, if we had not sent the surplus of manufactures out of this country, those of us who remain here could have no prosperity today. That was the start of the

work, and that is the support of the prosperity of today. And I hear on this side and the other, various expressions from small manufacturers not at all working for export trade, and they say, "Well, I have no interest in this business, it does not touch me at all; I am not influenced by it in any way whatever." Why, gentlemen, you all know, I think, as well as I do, that the very minute the market for our surplus products falls and there is no market for them and they remain here in this country, that minute prosperity departs from this land. And when it departs it affects every man; it affects you and me; it affects the exporter and it affects every manufacturer here, because his selling power is diminished by that much. It means dark days for us or prosperous days, according as we get that foreign business in our control or not. And it is our business, and I have no doubt it is the business of your Association, Mr. President, to seriously consider this foreign trade and in every way possible expedite the work that tends to strengthen the arms of our Association in foreign lands. As the National Association of Manufacturers, we are doing all that is proper to be done. We leave no field uncultivated; there is no avenue that we can take that we do not travel in the direction of the consummation of this one object of our work. I believe that you gentlemen are with me and with our association heart and hand in this one great movement; and I hope at your meetings that you will not dissolve until you have indorsed and have shown to the world your present standing with regard to the features that I have alluded to.

Now, gentlemen, we are having a meeting below. As I say, we have made a trade; I have come up here on a special condition, and that is that we can have the loan of your President after a while to talk to us at a time when it may suit his convenience. I shall also be glad if any of the rest of your members can drop in there. I notice some of our members up here, and I am glad to see them here. I am glad to note this exchange of courtesies. I believe that we manufacturers, whether we are in the same body or not, should co-operate in every way possi-

ble, be hail fellows well met, and you will all be received heartily if you drop in the room below. [Applause.]

Mr. ARTHUR H. LOWE. Mr. President, I move that a vote of thanks be extended to Mr. SEARCH for the encouraging and courteous words which he has spoken to us at this time.

The motion being seconded by Mr. JEROME HILL, was put to vote and carried unanimously.

The PRESIDENT. The next business is the reading of the report of the Secretary and Treasurer.

SECRETARY'S REPORT.

The event of the greatest personal moment which has occurred during the year has been the sudden death of President FREDERICK E. CLARKE on Nov. 6, 1899. While this sad occurrence robbed many of the members of a warm personal friend, it has deprived the Association of the services of a high degree of skill, which were earnestly devoted to the interests of this organization. At a meeting of the Board of Government held Dec. 23, 1899, the following resolutions were passed:

"WHEREAS by the death of FREDERICK E. CLARKE the community has been bereft of a man whose rare endowments were earnestly applied for many years to the successful administration of large enterprises in textile manufacturing, engineering, finance and the obligations of public life,

Be it Resolved, that the Board of Government of the New England Cotton Manufacturers' Association spread upon its records this tribute to the character and ability of FREDERICK E. CLARKE, President.

Voted that the Board of Government report its action at the next meeting of the Association."

The career of Mr. CLARKE was so wide spread in a great number of directions that his friends in Lawrence have compiled a memorial volume in remembrance. A short biographical sketch was contained in the last volume of the Transactions giving some of the occurrences of his active and influential life.

The Board of Government elected Mr. D. M. THOMPSON of Providence, R. I., to fill the vacancy for the unexpired term as President.

Mr. J. HERBERT SAWYER, who has been Auditor of the As-

sociation since 1882, resigned, as a departure would prevent him from attending to his duties, and Mr. C. E. ROBERTS, of Boston, was elected Auditor for the unexpired term.

During the year the Association has also lost by death Mr. JOHN DROWNE, of Dover, N. H., Col. JOSEPH H. KENDRICK, of Providence, R. I., and Mr. EDWARD P. TAFT, of Providence, R. I., biographical sketches of whom appear in the volumes of the Transactions for the year.

At the beginning of the year the membership of the Association was 530, which has been increased by the election of 56 at the Spring and Fall meetings. This number has been diminished by the death of the four members referred to and also by the resignation of eight, dropping on account of lapsed dues of five and non-confirmation of election of five, leaving in advance of this meeting a net membership of 564.

The Board of Government have held twelve meetings during the year at which the various affairs of the Association received due action.

The following diagram represents in graphical form the membership of the Association from its establishment.

The following table shows the membership of the Association at various meetings since its foundation in April, 1865, the number elected and the number of present members.

MEMBERSHIP OF THE ASSOCIATION.

Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected to Membership.
1	Apr. 20, 1865,	44	6	—
	July 19, 1865, Adj. Meeting,	—	1	—
2	July 18, 1866,	72	2	—
3	July 17, 1867,	—	1	10
4	Jan. 16, 1868,	108	4	14
5	July 15, 1868,	—	0	11
	Oct. 21, 1868, Adj. Meeting,	—	1	6
6	Apr. 21, 1869,	—	2	20
7	Oct. 20, 1869,	—	2	8
8	Apr. 20, 1870,	144	0	9
9	Oct. 19, 1870,	—	1	5
10	Apr. 19, 1871,	—	2	9
11	Oct. 18, 1871,	—	2	16
12	Apr. 17, 1872,	166	4	27
13	Oct. 16, 1872,	—	3	12
14	Apr. 16, 1873,	175	1	13
15	Oct. 15, 1873,	—	3	19
16	Apr. 15, 1874,	189	1	12
17	Oct. 21, 1874,	—	0	7
18	Apr. 21, 1875,	199	5	13
19	Oct. 27, 1875,	—	2	18
20	Apr. 26, 1876,	200	1	13
21	Oct. 25, 1876,	—	3	14
22	Apr. 25, 1877,	213	4	20
23	Oct. 31, 1877,	—	3	12
24	Apr. 24, 1878,	210	6	6
25	Oct. 30, 1878,	—	4	12
26	Apr. 30, 1879,	205	4	10
27	Oct. 29, 1879,	—	6	17
28	Apr. 28, 1880,	219	2	16
29	Oct. 27, 1880,	—	3	13
30	Apr. 27, 1881,	231	3	12
31	Nov. 30, 1881,	—	2	5
32	Apr. 26, 1882,	231	2	9
33	Oct. 25, 1882,	—	3	7
34	Apr. 25, 1883,	240	5	15
35	Oct. 31, 1883,	—	4	10
36	Apr. 30, 1884,	247	4	9
37	Oct. 29, 1884,	—	2	3
38	Apr. 29, 1885,	225	3	3
39	Oct. 28, 1885,	—	7	8
40	Apr. 28, 1886,	225	4	7
41	Oct. 27, 1886,	—	6	8

Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected to Membership.
42	Apr. 27, 1887,	234	5	13
43	Oct. 27, 1887,	—	2	3
44	Apr. 25, 1888,	241	11	15
45	Oct. 31, 1888,	—	6	13
46	Apr. 24, 1889,	242	4	6
47	Oct. 30, 1889,	—	4	9
48	Apr. 30, 1890,	246	6	7
49	Oct. 29, 1890,	—	9	11
50	Apr. 29, 1891,	254	4	4
51	Oct. 28, 1891,	—	5	8
52	Apr. 27, 1892,	244	12	12
53	Oct. 26, 1892,	—	15	19
54	Apr. 26, 1893,	259	6	10
55	Oct. 25, 1893,	—	8	9
56	Apr. 25, 1894,	270	12	14
57	Sept. 27, 1894,	292	15	21
58	Apr. 24, 1895,	383	74	94
59	Oct. 24, 1895,	422	42	48
60	Apr. 29, 1896,	450	23	30
61	Sept. 22, 1896,	459	18	19
62	Apr. 28, 1897,	495	41	44
63	Oct. 27, 1897,	523	37	39
64	Apr. 27, 1898,	535	21	24
65	Sept. 29, 1898,	554	16	18
66	Apr. 26, 1899,	564	31	34
67	Oct. 5, 1899,	580	22	22
68	Apr. 25, 1900,	603	41	41

The headquarters of the Association have been well patronized by members during the year and the bound volumes of the Transactions and also the books of reference and technical papers have been frequently consulted by those without the Association as well as by its members. The rooms have been called into frequent use by members for various business conferences during the year.

The Transactions of the following societies are sent to the Association.

Transactions of Technical Societies.

American Society of Civil Engineers,	New York.
American Society of Mech. Engineers,	New York.
American Institution of Elect. Engineers,	New York.
Boston Chamber of Commerce,	Boston.
Bureau of the American Republics,	Washington, D. C.
Consular Reports, Bureau of Statistics,	Washington, D. C.
National Association of Wool M'f'rs.,	Boston.
National Electric Light Ass'n.,	New York.
Western Society of Civil Engineers,	Chicago.

List of Periodicals Kept on File.

American Wool and Cotton Reporter,	Boston.
Bennett's Weekly,	New York.
Boston Journal of Commerce,	Boston.
Cassier's Magazine,	New York.
Dry Goods Economist,	New York.
Electrical Review,	New York.
Engineering Record,	New York.
Fibre and Fabric,	Boston.
Iron Age,	New York.
Manufacturers' Record,	Baltimore.
Mill and Shop,	Boston.
New England Shoe and Leather Association Monthly Gazette,	Boston.
Power,	New York.
Protectionist,	Boston.
Textile Manufacturers' Journal,	New York.
Textile Recorder,	Manchester, England.
Textile Record of America,	Philadelphia.
Textile World,	Boston.

TREASURER'S REPORT.

C. J. H. WOODBURY, TREASURER, IN ACCOUNT WITH THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

April 1, 1899, to April 1, 1900.

DEBTORS.

Cash,	$386 28	
Active membership dues,	2,245 00	
Associate membership dues,	1,120 00	
Active admission fees,	340 00	
Associate admission fees,	375 00	
Interest,	57 63	
Sale of Transactions,	33 50	
Advertising,	1,010 00	
Medal and certificate fund,	1,000 00	
Engraving,	3 00	
Miscellaneous,	53 00	
Postage telegrams and express,	40	
Total,		$6,623 81

CREDITORS.

Board of Government,	$139 12
Office rent,	399 96
Secretary and Treasurer,	750 00
Reports of meetings,	156 00
Notices and stationery,	112 04
Meeting expenses,	125 56
Printing and distributing Transactions,	1,706 56
Badges,	58 65
Amount forward,	$3,447 89

Amount forward,	$3,447 89	
Stenographer and proof,	556 29	
Postoffice box,	10 00	
Advance copies of papers,	177 40	
Engraving,	165 00	
Miscellaneous,	90 39	
Postage, telegrams and express,	204 42	
Office supplies and furniture,	123 39	
Medal and certificate fund.	232 45	
Securities and cash,	1,616 58	
Total,		$6,623 81

AUDITOR'S REPORT.

I hereby certify that the amounts from April 1, 1899, to April 1, 1900, are correctly cast, that all payments are properly vouched for by bills approved by the Auditing Committee of the Board of Government, that the funds are kept on deposit in the name of the New England Cotton Manufacturers' Association, and that the amount of the deposit April 1, 1900, agrees with the balance in the books, viz., $616.58.

The security in which the Association funds have been invested has been examined.

C. E. ROBERTS,
Auditor.

BOSTON, April 5, 1900.

The earnings of the Association for the year may be placed as

465 active members at $5.00,	$2,325 00	
111 associate members at $10.00,	1,110 00	
37 active admissions at $10.00,	370 00	
19 associate admissions at $25.00,	475 00	
Advertising,	770 00	
Miscellaneous,	91 13	
Total,		$5,141 13

The expenses of the Association were $5,007.23.

The bills receivable are:

Active dues,	$300 00	
Associate dues,	120 00	
Active admission,	10 00	
Associate admission,	50 00	
Transactions,	50	
Advertisements,	30 00	
Total,		$510 50

There are no bills payable.

The income derived from advertisements has enabled the Association to be conducted on the same basis as other technical organizations which are supported by higher assessments as well as by advertisements in their transactions. The amounts from this source have amounted in the several volumes of the Transactions to:

63	Philadelphia, September, 1897,	$385 00
64	Boston, April, 1898,	420 00
65	Crawford House, September, 1898,	450 00
66	Boston, April, 1899,	550 00
67	Montreal, October, 1899,	445 00
68	Boston, April, 1900, (already under contract,)	325 00

The following table presents the finances of the Association for the past ten years.

Fiscal Year Ending April 1.	MEMBERSHIP.		TRANSACTIONS.			FINANCES.				Cost per Page of Transactions for each member Cents.
	Enrollment.	Members Elected.	Volume Number.	Pages in Volume.	Pages for Year.	Cash Receipts.	Expenses.	Cost per Page of Transactions.	Cost per Member.	
1891	246	18	48	43	105	$1,142 00	$ 926 08	$8 82	$3 76	3.59
			49	62						
1892	254	12	50	129	189	1,260 68	1,374 46	7 27	5 41	2.86
			51	60						
1893	244	31	52	63	157	1,678 33	1,603 25	12 22	6 57	6.33
			53	94						
1894	259	19	54	84	170	1,414 58	1,807 60	10 63	7 03	4.14
			55	86						
1895	270	35	56	73	303	1,947 07	1,957 64	6 46	6 71	2.21
	292		57	230						
1896	383	142	58	310	637	4,579 19	3,636 31	5 71	8 59	1.34
	422		59	327						
1897	450	49	60	269	628	3,710 02	3,980 34	6 33	8 67	1.43
	459		61	359						
1898	495	83	62	353	806	4,717 08	4,333 85	5 38	8 28	1.18
	523		63	453						
1899	535	42	64	321	701	4,713 56	4,775 97	6 81	8 62	1.23
	554		65	380						
1900	564	56	66	464	760	5,237 53	5,007 23	6 57	8 63	1.14
	580		67	296						

Respectfully submitted,

C. J. H. WOODBURY,

Secretary and Treasurer.

April 5, 1900.

Mr. FREDERICK A. FLATHER. I move that the report of the Secretary and Treasurer be accepted.

The motion being duly seconded was carried.

Mr. STEPHEN A. KNIGHT. Mr. President, I beg to offer the following resolution:

Voted, that this Association confirm the resolutions passed by the Board of Government to the memory of FREDERICK E. CLARKE, and make the resolutions a portion of the records of this meeting.

The resolution being duty seconded was put to vote and adopted unanimously.

The following papers were read:

Waste in Cotton Mills.

EDWARD W. THOMAS, Lowell, Mass.

Read by the Secretary in the absence of the author.

Latin American Trade in Cotton Fabrics.

WILLIAM WHITTAM, JR., Woonsocket, R. I.

Southern Cotton Manufacturing.

M. F. FOSTER, Milford, N. H.

TOPICAL QUESTIONS.

119. In which class of machinery, as at present running, is it desirable to improve the most to obtain a minimum cost in manufacturing?

No discussion.

120. English practice has been in the direction of separating the business of spinning from that of weaving. What are the advantages of this separation? Is there any such tendency discernible in American practice at the present time?

No discussion.

SECOND SESSION.

WEDNESDAY AFTERNOON, APRIL 25, 1900.

Meeting called to order at 2 P. M., President THOMPSON in the chair.

The following papers were read:

A Critical Moment in the History of Export Trade in Cotton Manufactures.

Dr. WM. P. WILSON, Philadelphia, Pa.

Belting: From Hide to Pulleys.

J. H. BURGHARDT, Boston, Mass.

Read by the Secretary in the absence of the author.

Lighting Buildings by Refracted Daylight through Luxfer Prisms.

GEORGE K. MALTBY, Boston, Mass.

Discussed by Mr. EDWARD ATKINSON.

Warming and Ventilation of Mills.

Prof. S. HOMER WOODBRIDGE, Boston, Mass.

Read by the Secretary in the absence of the author.

Discussed by Messrs. C. J. H. WOODBURY and EDWARD ATKINSON.

TOPICAL QUESTIONS.

121. What can be offered on the subject of the influence of moisture in the air affecting the strength of yarn?

Discussed by Mr. FRANK P. VOGL.

122. What is the best temperature and humidity for good spinning on fine counts?

No discussion.

123. What is the best way to prevent double yarn on spinning frames where double boss rolls are used?

No discussion.

124. What is the best covering for the top rolls used on frames and mules that are to spin various numbers?

No discussion.

125. What is the best taper or length of wind for mule cops on number 37 filling?

No discussion.

126. Is it practical to spin numbers finer than 65s on larger rings than 1½ with spindle running 9,000 revolutions?

No discussion.

The SECRETARY. At the meeting at Montreal there was a paper read on The American Stoker, by Mr. BYRON ELDRED, which was a success in every respect except that the stokers were not there to be seen. Mr. ELDRED has sent in an invitation to the members of this Association to visit the installation of the American Stokers at Chestnut Hill reservoir, and the party will start from in the front of this building in automobiles at 4.30 and will return about 6. Mr. ELDRED wishes to know how many to provide for, and if the gentlemen who would like to go on that automobile ride at 4.30, which will be at the time of adjournment decided upon by the Board of Government, I understand, will they kindly raise their hands. [To Mr. ELDRED.] Will you count them?

Mr. BYRON ELDRED. Seventeen, I make it. We will provide for 25 or 30.

The SECRETARY. Mr. SANBORN, the General Manager of the National Association of Manufacturers, has come up here to re-inforce the general invitation that the members of this Association will attend their evening session, which will be held in Lorimer Hall, and will be devoted to subjects to greatest interest to this Association, the program having been made up with that in view. Mr. JOHN C. EAMES will speak on Foreign Trade in American Cotton; Hon. WILLIAM B. RICE of Boston, on Opportunities of Foreign Trade in American Shoes; Mr. RICHARD YOUNG of New York, The Evolution of Leather Making in America and the Opportunities of Export Business; Mr. EDWARD H. SANBORN will speak upon Packing of American Manufactures for Foreign Consumption with stereopticon illustrations. The meeting will be at 8 o'clock this evening; no tickets required.

The PRESIDENT. Before passing to the next topic I will call Vice-President MCDUFFIE to the chair.

Vice-President FRED C. MCDUFFIE in the chair.

Mr. D. M. THOMPSON. Gentlemen, having received a visit from the President of the National Association of Manufacturers this morning, it is a duty as well as a pleasure on the part of this Association that the courtesy should be returned. For that purpose it has been indicated that about 4 o'clock this afternoon would suit their convenience. I have, therefore, called the Vice-President to the chair that he may continue in charge of the meeting, and I will excuse myself for the purpose of presenting the compliments of this Association to the President and members of the National Association. I would also suggest that a committee of at least one or two be appointed who shall attend me on that visit. I will await your pleasure.

The VICE-PRESIDENT. You hear the suggestion of your President, gentlemen. What action will you take in regard to

it? The suggestion, as I understand it, is that a committee of one or two be appointed to accompany him.

Mr. WALTER E. PARKER. I move that Mr. ARTHUR H. LOWE be a committee of one to accompany the President.

The motion, being duly seconded, was put to vote and carried.

The VICE-PRESIDENT. It is so ordered. Mr. LOWE will accompany the President.

The SECRETARY. I have been requested to modify that invitation to go on the automobiles, because there has been a difficulty in obtaining a sufficient number of automobiles to convey the whole party. They have therefore chartered an electric car, and under the guidance of Mr. ELDRED you will be taken down to the loop at the Park Street station and taken out over the same route, but upon the rails instead, to the pumping station, leaving here at half past four as previously stated.

THIRD SESSION.

THURSDAY MORNING, APRIL 26, 1900.

Meeting called to order at 10 A. M., President Thompson in the chair.

The PRESIDENT. Gentlemen, you will please come to order. The first question or matter which I am pleased to call to your attention this morning is one which will give you all much of pride and satisfaction. The presence of the distinguished gentleman who honors this occasion suggests to my mind the thought that while the New England Cotton Manufacturers' Association is all that its name implies, yet it has in fact grown wonderfully since its birth a third of a century since and has of late developed into an organization of national power and influence. Its membership of more than six hundred is a distinctively representative body in the interests of an industry of great value to the country and one in which the State of Massachusetts has a large share.

Notwithstanding the greater sphere within which this Association is now moving, yet it is a matter which we are pleased to recall and recognize that it is, in an important sense, of Massachusetts origin. The New England Cotton Manufacturers' Association in common with many other interests owes very much to the Commonwealth of Massachusetts whose influence has been a wise contributing factor of great power in shaping the destinies of our common country.

I have therefore very great pleasure in presenting to you His Honor, JOHN L. BATES, Lieutenant Governor of the Commonwealth of Massachusetts. [Applause.]

Hon. JOHN L. BATES. Mr. President, Gentlemen of the New England Cotton Manufacturers' Association, I notice that the subject which is printed nearest my name on the programme is a trifle peculiar: Systems of Payment on Mules. [Laughter.] I must confess ignorance at the start. I don't know anything about this subject except what the rest of the world knows in common with me. I have no particular fondness for the creature that is therein specified. I never drive him when I can help it, and then not very successfully, and I never have attempted to ride him but once, and then for only a brief time, when he and I parted company, not without his consent, and I was not unwilling, only I did not like the manner of his leaving. [Laughter.] I cannot talk to you on that subject. My best advice to you is to leave him alone, for no matter what the system of payment on which you take him, you are sure to be beaten in the end [Laughter], and generally beaten by the business end of the mule. [Laughter and applause.] My best advice is, Mr. President, though you can buy him for 50 cents down and 50 cents a week, though you can buy him for cash or on 30 days' credit, the best thing you can do is to leave him alone.

I notice there are many subjects which are no doubt interesting, but they are all of them subjects about which I know as little as about the first one. I cannot even answer those interesting conundrums which you have put on the end of the programme for this morning's session.

But I am not here for that purpose, for which you are probably thankful. I am here, as the President has said, simply to say a word of welcome on behalf of the Commonwealth of Massachusetts; here not only by your invitation, but at the request also of His Excellency the Governor, to extend his most cordial greetings to you. I have learned since I came in that this,

although called the New England Cotton Manufacturers' Association, has a membership practically from all sections of the country and of Canada. It reminds me of the fact that New England's influence is a little inclined to spread itself over all the earth, and I am glad to welcome you not merely as a New England Association, but, as your presiding officer tells me, really as an American Association. We welcome you on behalf of the Commonwealth as we would welcome men who are engaged in the solution of problems that involve the happiness and the prosperity of our people in common with that of the rest of the people of America. We welcome you as the representatives of an industry in which the Commonwealth of Massachusetts is peculiarly and largely interested. I am not here to give you statistics — only two — to emphasize those two. Under the last census, in 1895, the Commonwealth of Massachusetts had in the cotton industry invested a capital of about $100,000,000. Its product for the year 1895 was $94,000,000. The number of operatives was 83,000 and a few more. You go out upon our streets anywhere throughout the Commonwealth, and one person in every ten that you meet will be directly interested in one way or another in the cotton industry of this state. You connot meet a man or a woman or a child whose happiness and prosperity is not promoted by the prosperity of this industry, for when we receive that $94,000,000 a year for the product of our cotton mills, it is to go to the grocer and to the dry goods merchant and through them into all the other lines of trade and help increase the prosperity of them all. Hence we welcome you as men who are engaged in an industry that constitutes one-tenth of all the mannfacturing industry of this Commonwealth of Massachusetts.

It is customary on such occasions for some one to refer to the historic places in the old Bay State. You, who have come from a distance, I know will be glad if the opportunity is presented of standing upon the most famous rock in all the world — Plymouth, where began the making of the world again — where began a race of men. We have but just celebrated the day that

is devoted particularly to commemorating the deeds of Lexington and Concord. No man can stand on Lexington Green without being invigorated by the breath of liberty that he there draws in. He cannot go to Concord Bridge without drinking from the river of freedom. He cannot stand beneath the tall shaft across the river that marks Bunker Hill without remembering the words of WEBSTER and feeling that the deeds of those men there are constantly rising as does the shaft to meet the sun in its coming. But in this presence, I say, visit these places if you can, but when you have visited them, come back and read the old legend upon the seal of the Commonwealth of Massachusetts. It is this: that she grasps the sword only that she may enjoy the blessings of peace under the conditions of liberty. And we would have you understand that the old Commonwealth has been as prominent in the triumphs of peace as she has been in the triumphs which are represented by the places which I have mentioned.

I would have you go down to the city of New Bedford, for instance, some of whose representatives have been here this morning; go down to that old whaling city; learn how for generations that city depended upon the hardy courage of the men who went down to the great deep and pulled forth the leviathan, and from this great fish came the wealth which made that city's name famous throughout the whole country. Learn how, when the fish of the sea failed, those enterprising men, with no lack of courage, turned their backs on the old vessels, tied them, left them to rot at the wharves, and began digging foundations for the cotton manufactures that you find in that city today, and on those foundations have built a larger and a greater city than before.

Go up to the Merrimack, see Lawrence and Lowell, and how the enterprise in times of peace of the people of the state has harnessed that great river to the chariots of manufacture and caused it to labor for men. Recognize in these facts and in these cities and in many another like them in this Commonwealth, the fact that Massachusetts believes that the triumphs

of peace which have been made by her people are second only in importance to the triumphs which have been made upon her soil in the interest of liberty and in the interest of government of men by men.

Go down to the old ocean, if you will, and listen to it chanting upon her shores its solemn requiem. Go out to the Berkshire Hills and listen to the singing of the breezes through the treetops of her forests. But learn that she has a music that to the ears of her people is as sweet as these. Come to these great manufacturing centers and listen again to the song of the spindle, listen to the chanting of the loom, and there you will learn that she has recognized that that music, bringing as it does prosperity and happiness to her people, is as sweet as any music that can fall upon the ears of her inhabitants. And she welcomes you today because she recognizes the fact that you are the men who are touching the magic keys that bring forth this melody in which she is such a great participant, which she has enjoyed so much, which has meant so much for her welfare. She welcomes you; she trusts indeed, that your convention, so auspiciously begun yesterday, may end with equal satisfaction. She trusts that your deliberations may end in profit not only to you individually but to the great industries that you represent in this state and throughout the land. Her best wishes will go with you for a continuance of this prosperity wherever you may go. [Applause.]

The PRESIDENT. Gentlemen, we have listened with very great pleasure to the address of the Lieutenant Governor, and I wish to express to him our thanks for the very entertaining and able manner in which he has presented his welcome.

The SECRETARY. Mr. President, the committee on nominations have placed in my hands this report of the nominations to fill the vacancies in office:

BOSTON, April 26, 1900.

REPORT OF COMMITTEE ON NOMINATIONS.

The committee appointed to nominate candidates for President, two Vice-Presidents and two Directors, to be balloted for at this meeting, report the following nominations:

President,

D. M. THOMPSON, Providence, R. I.

Vice-Presidents,

CHARLES H. RICHARDSON, Clinton, Mass.
GEORGE H HILLS, Fall River, Mass.

Directors for 3 years,

HERBERT E. WALMSLEY, New Bedford, Mass.
CHARLES H. FISH, Dover, N. H.

Respectfully submitted,

STEPHEN A. KNIGHT,
S. S. SPENCER,
GEORGE W. WEEKS,
F. M. MESSENGER,
H. C. PERHAM,
Nominating Committee.

The President appointed as a committee to distribute, collect and count ballots for the election of officers to fill the vacancies, Messrs. GEORGE P. GRANT, Jr., and GEORGE OTIS DRAPER. The committee thereupon proceeded to the discharge of their duties, and later in the session submitted the following report:

REPORT OF COMMITTEE ON ELECTION OF OFFICERS.

The committee appointed to distribute, collect and count ballots for officers to fill vacancies occurring by limitation have attended to their duties and report that 54 ballots have been cast, all of which are for the candidates named below:

For President,	D. M. THOMPSON, Providence, R. I.
Vice-Presidents,	CHARLES H. RICHARDSON, Clinton, Mass. GEORGE H. HILLS, Fall River, Mass.
Directors for 3 years,	HERBERT E. WALMSLEY, New Bedford, Mass. CHARLES H. FISH, Dover, N. H.

Signed,

GEORGE P. GRANT, Jr.,
GEORGE OTIS DRAPER, } *Committee.*

The PRESIDENT. You have heard the report of the committee and I announce the election of the gentlemen reported as officers of this Association for the ensuiug year.

The following papers were read and topical questions discussed:

Systems of Payment on Mules.

JOHN B. CUDLIP, Marysville, N. B.

Read by the Secretary in the absence of the author.

Methods of Cost Finding in Cotton Mills. (Second paper.)

WILLIAM G. NICHOLS, Chester, S. C.

Application of Mechanical Draft to Stationary Boilers.

WALTER B. SNOW, Boston, Mass.

The Height and Area Required for Chimney Draft.

H. G. BRINCKERHOFF, Boston, Mass.

Read by the Secretary in the absence of the author.

Discussed by Mr. C. J. H. WOODBURY.

TOPICAL QUESTIONS.

127. What is the maximum length to put No. 100s on bobbins?

No discussion.

128. How far is it practicable to substitute frames for mules in spinning filling?

Discussed by Messrs. FRANK M. MESSENGER, JOHN ECCLES, A. H. GULLIVER, D. M. THOMPSON and ALFRED E. ADAMS.

129. What means have been found useful in diminishing the number of oil stains?

No discussion.

130. What steam pressure should be carried on slashers running on colored work, and what is the best means of returning to boilers the condensation from slashers?

No discussion.

131. What is the quantity of steam properly required for slashers and the best means of applying the same?

No discussion.

132. What is the best method of utilizing the waste products of a mill?

No discussion.

The SECRETARY. The Board of Government present with their approval the following names of candidates for membership:

FOR HONORARY MEMBERSHIP.

MOSES PIERCE, 274 Broadway, Norwich, Conn.
Proposed by vote of the Board of Government.

FOR ACTIVE MEMBERSHIP.

THOMAS BARRETT, Jr., Pres. Langley & Aiken Mills, Augusta, Ga.
By Mr. D. M. THOMPSON.

ALFRED H. BURNHAM, Mgr. Glasgow Mills, Huntington and Jasper Sts., Philadelphia, Pa.
By Mr. ADELBERT R. YOUNG.

WILLIAM H. CADWELL, Supt. Jackson Company, Nashua, N. H.
By Mr. WILLIAM D. CADWELL.

CHARLES H. COLLINS, Supt. Berkeley Co., Ashton, R. I.
By Mr. A. H. GULLIVER.

B. B. COMER, Pres. and Treas. Avondale Cotton Mills, Birmingham, Ala.
By Mr. H. T. WHITIN.

CAESAR CONE, Pres. Proximity Mfg. Co., Greensboro, N. C.
By Mr. EDWARD T. GARSED.

AUGUSTUS DE CORT, Treas. Beacon Mfg. Co., P. O. Box 2815, Boston, Mass.
By Mr. WILTON H. SPENCER.

T. C. DUNCAN, Treas. Union Cotton Mills, Union, S. C.
By Mr. W. B. SMITH WHALEY.

CHARLES ESTES, Pres. John P. King Mfg. Co., Augusta, Ga.
By Mr. D. M. THOMPSON.

FREDERICK B. GORDON, Pres. and Gen. Mgr. Columbus Mfg. Co., Columbus, Ga.
By Mr. CHARLES H. GORTON.

JOHN T. GREENWOOD, R. Greenwood & Bault, 4720 Leiper St., Frankford, Philadelphia, Pa.
By Mr. JOHN H. LORIMER.

HENRY P. MEIKLEHAM, Supt. Aiken Mfg. Co., Bath, S. C.
By Mr. ARTHUR C. FREEMAN.

JAMES SUMTER MOORE, Sec'y. and Treas. Olympia & Richland Cotton Mills, Columbia, S. C.
By Mr. W. B. SMITH WHALEY.

JOHN F. REARDON, Agt. Falls Co., Norwich, Conn.
By Mr. J. K. RUSSELL.

FREDERIC W. REYNOLDS, Supt. Potomska Mills, Box 299, New Bedford, Mass.
By Mr. JOHN T. MEATS.

WALTER RIGBY, Supt. Ballou Yarn Converting Co., 189 Charles Street, Providence, R I.
By Mr. EDWARD R. BALLOU.

WILLIAM H. RITTER, Gen. Supt. Johnson & Johnson, New Brunswick, N. J.
By Mr. HENRY D. MARTIN

BENJ. H. ROBERTS, General Mill Supplies, 163 Grove St., Fall River, Mass.
By Mr. C. E. HATHAWAY.

THOMAS HENRY SMITH, Jamestown Cotton Mill, Jamestown, N. Y.
By Mr. JOHN T. MEATS.

T. B. STEVENSON, Supt. Readville Mill, Hyde Park, Mass.
By Mr. GEORGE E. SPOFFORD.

GEORGE W. TURNER, Supt. Argo Mills, Gloucester, N. J.
By Mr. C. R. MAKEPEACE.

EUGENE F. VERDERY, Pres. Warren Mfg. Co., Augusta, Ga.
By Mr. GEORGE R. STEARNS.

JAMES P. VERDERY, Pres. Enterprise Mfg. Co., Augusta, Ga.
By Mr. D. M. THOMPSON.

JOSEPH WATTERS, Supt. Osborn Mills, Fall River, Mass.
By Mr. W. G. MCLOON.

BENJAMIN WILCOX, Treas. City and Bristol Mfg. Co., New Bedford, Mass.
By Mr. GEORGE A. AYER.

JOHN B. WILD, Pres. Oneita Knitting Mills, Utica, N. Y.
By Mr. HENRY F. MANSFIELD.

FOR ASSOCIATE MEMBERSHIP.

H. B. ASHTON, Agent S. A. Felton & Son Co., 153 Adams St., Medford, Mass.
By Mr. FREDERICK A. FLATHER.

EDWIN BARNES, Hetherington & Sons, Textile Machinery, Equitable Building, Boston, Mass.
By Mr. E. W. THOMAS.

F. H. BISHOP, Gen. Mgr. Universal Winding Co., 226 Devonshire St., Boston, Mass.
By Mr. A. M. GOODALE.

ALBERT L. CALDER, 2nd, Cotton Broker, Box 206, Providence, R. I.
By Mr. H. H. SHUMWAY.

JOSEPH L. CUSHING, Mfr. of Cotton Conveying Systems, Lowell, Mass.
By Mr. HAVEN C. PERHAM.

RICHARD H. HILL, Gen. Sales Agt. James Hunter Machine Co., 70 Kilby St., Boston, Mass.
By Mr. D. M. THOMPSON.

FRANCIS E. MACOMBER, Mill Supplies, 21 Pearl St., Boston, Mass.
By Mr. JAMES GEE.

D. K. McLAREN, Mfr. of Leather Belting, 751 Craig St., Montreal, P. Q., Canada.
By Mr. ALFRED HAWKESWORTH.

CHARLES B. MOORE, Agent Knowles Steam Pump Works, 54 Oliver St., Boston, Mass.
By Mr. D. M. THOMPSON.

JOHN H. NELSON, Treas. William Firth Co., Box 1460, Boston, Mass.
By Mr. WILLIAM FIRTH.

E. R. RICHARDSON, Asst. Treas. American Machine Co., Pawtucket, R. I.
By Mr. CHARLES E. RILEY.

J. FOSTER SEARLES, Treas. American Loom Co., Readville, Mass.
By Mr. D. M. THOMPSON.

C. T. SWITZLER, Selling Agt., The Plomo Specialty Mfg. Co., 34 Oliver St., Boston, Mass.
By Mr. ARTHUR PARKINSON.

ALLISON W. TRAFFORD, Mfr. of Ring Travelers, Fall River, Mass.
By Mr. RICHARD THACKERY.

The President appointed Mr. FREDERICK A. FLATHER and Mr. ARTHUR H. GULLIVER a committee to distribute, collect and count ballots.

The committee reported later that they had attended to their duties and that each of the candidates named had received unanimous election, each of them receiving the total of 47 votes cast.

On motion of Mr. FRED C. MCDUFFIE, duly seconded,

Voted, that the thanks of this Association be tendered to Dr. WILLIAM P. WILSON, Director of Philadelphia Commercial Museum, for his presence at this meeting and his able paper, and the great interest he has manifested in the very important work which is of such vital concern to the members of this Association.

On motion of Mr. HERBERT E. WALMSLEY, duly seconded,

Voted, that the thanks of this Association be tendered to His Honor,

THOMAS N. HART, Mayor of Boston, for his address of welcome on behalf of the city.

On motion of Mr. WALTER E. PARKER, duly seconded,

Voted, that we recognize the long distance telephone as an essential adjunct to the conduct of business affairs and a great convenience as a means of personal communication, and acknowledge with thanks the courtesies which the American Telephone and Telegraph Company have extended to the members of this Association.

On motion of Mr. STEPHEN A. KNIGHT, duly seconded,

Voted, that the thanks of this Association be tendered to the New England Telephone and Telegraph Company for their courtesy in providing telephone booths which afforded to the members facilities for communication during this meeting.

On motion of Mr. JOHN ECCLES, duly seconded,

Voted, that the thanks of this Association be tendered to His Honor, Lieutenant Governor of Massachusetts, for his able and eloquent address of cordial welcome.

On motion of Mr. S. S. SPENCER, duly seconded,

Voted, that the thanks of this Association be tendered to Messrs. GEORGE K. MALTBY, Prof. S. HOMER WOODBRIDGE, WALTER B. SNOW and HENRY I. HARRIMAN for the valuable and interesting papers which they have contributed to this meeting, and that the secretary be and is hereby directed to convey to them the thanks of this Association for their several marks at attention to its interest.

The following paper was read.

Ring Spinning.

ALFRED E. ADAMS, Whitinsville, Mass.

FOURTH SESSION.

THURSDAY AFTERNOON, APRIL, 26, 1900.

Meeting called to order at 2 P. M., President THOMPSON in the chair.

The following papers were read:

The Harriman Automatic Loom.

HENRY I. HARRIMAN, Hyde Park, Mass.

Cotton Mixing.

FRANK M. MESSENGER, No. Grosvenor Dale, Conn.

The Value of a Horse Power.

SAMUEL WEBBER, Charlestown, N. H.

TOPICAL QUESTIONS.

133. What is the best method of treating belts and their proper use?

134. Is it advisable to warm picker rooms with air drawn from the main mill?

135. Are automatic heat regulators an advantage both in economy and comfort?

136. What is the best method of cleaning mill windows?

138. What is the best method of introducing kerosene oil into boilers, and what have been the results from its use?

139. Do water tube boilers contain advantages for steam plants in mills?

140. Do separators remove enough of the oil from condensed steam to prevent all injury to the boilers?

Consideration of the foregoing topical questions postponed until the next meeting.

The PRESIDENT. The papers presented and assigned for this session have been disposed of in due and proper form. There are topical questions which may be considered as unfinished business. It is evident that this is in a measure an unusual occasion.

There are several associations holding their conventions in Boston during the present week. Our Association and the National Association have some matters of interest common to both, owing to quite a number of our members who are members of the National. When you recall the fact of so many unusual attractions which have been arranged through the hospitality of the City of Boston and its Citizens' Committee, designed for the pleasure of its guests, we may feel justly proud of so large an attendance of our own members and of visiting friends, who have all been very heartily welcomed.

In view of these conditions and the necessary preparations for the banquet this evening and the reception which precedes it at 5 o'clock, it may be your pleasure to defer the discussion of the topical questions. I submit the matter for your consideration.

Mr. WALTER E. PARKER. I move that we do now adjourn *sine die*.

The motion was seconded by Mr. STEPHEN A. KNIGHT, and being put to vote was declared carried, and the President thereupon declared the meeting adjourned.

Adjourned,

Attest:

C. J. H. WOODBURY,

Secretary.

TRANSACTIONS.

FIRST SESSION

WEDNESDAY MORNING, APRIL 25, 1900.

The Association met in Chipman Hall at 11 A. M., President THOMPSON in the chair.

The PRESIDENT. [After the transaction of business.] The first paper in order is Waste in Cotton Mills by Mr. EDWARD W. THOMAS of Lowell, Mass.

The SECRETARY. Mr. President, I have just received a telegram from Mr. THOMAS: "A severe cold and hoarseness will prevent my attending meeting and reading paper." And as I did not have an opportunity to obtain the services of some one else, I will read the paper. Mr. THOMAS'S work has been of such value that to be known and studied it ought to be read in full by every person at the mill. And I will say in this connection that this is a paper on a subject for which the Secretary has been trying to obtain writers for the last five years.

WASTE IN COTTON MILLS.

EDWARD W. THOMAS, Lowell, Mass.

Incident to the various matters of importance, which confront the managers of mills, is the one of the waste account. This is of utmost importance to the manufacturer in several ways.

First, the loss beyond the control of the manufacturer, due to the condition in which the cotton is delivered to mill, owing to the very negligent way it is protected by covering when compressed.

Second, the waste due to the various operations throughout the mill, and the duty imposed upon us to bring this amount down to the lowest possible percentage consistent with quantity and quality of production.

Considering the first problem, it is common knowledge and experience with us all, that no other commodity is handled, packed and delivered to northern mills in so careless and negligent manner as cotton. This, too, when it is considered that all tare must be paid for at full price of actual contents of the bales; this system has prevailed for years, and all kinds of arguments have been used to convince the producer and shipper to give us better protected and better ginned cotton, and it is with extreme gratification that now a large interest has been developed by the producer, ginner and factor to give us cleaner cotton, free, so far as is possible, from sand, dirt, seed, etc., as well as bringing the tare down to a minimum weight. The waste from covering, hoops, seed, dirt and dust is at the present time of considerable importance to the manufacturer, and to simply show

what it means, I cite the following: In one large manufacturing concern which used in 1899, 71,708 bales of cotton,

The Gross lbs. purchased	35,987,928 lbs.,	71,708 bales.
Hoops,	531,960 lbs. =	1.48%
Sacking and ropes,	915,349 " =	2.54%
Seed,	1,901,276 " =	5.28%
Dust, etc.,	210,056 " =	.58%
	3,558,641 lbs.	9.88%

or per bale 49.62 lbs. Taking this at five cents per pound, and deducting the amount received for the sale of the waste, and the amount lost to this one concern for the year would be $167,797. The computation of the loss at any higher average price than five cents per pound can be readily computed. At five cents per pound this loss to the mill was $2.34 per bale. With reasonably clean cotton and proper covering, the projectors of the round bale system agreed to give, and have in fact accomplished a very great saving. It is to be hoped that the success thus far assured by them may still be continued, and the field fully developed by them and others, so that our loss from this account may be brought down to a minimum amount, as the present loss sustained by the manufacturers, in the North, amounts at the present day to millions of dollars. The selling price of bagging, hoops, seed and dust does not vary as the price of cotton (and to-day is selling at extremely low prices), and gives the manufacturer but little opportunity to recoup in part for the price he has to pay for his tare.

GENERAL WASTE IN MANUFACTURING.

The general classes of waste made in the various operations throughout the mill may be classed broadly into soft and hard.

Soft Waste. Various classes of this waste are reworked in many mills, especially the card, drawing and roving wastes, the manner of working varying in different mills. Wherever a mill is manufacturing a special kind or kinds of fabrics, where card waste may be reworked by itself, either in warp or filling, or

both, the problem in a measure takes care of itself; but where card strippings, say from finisher cards, are injudiciously mixed in with regular cotton, unless extreme care is used, the tendency is to produce uneven, unclean, and poor quality of yarn. The same may be said of the reworking of alley, card can, drawing and roving waste. Unless this waste is properly opened, and the whole lot of these classes of waste most judiciously mixed in the bins with raw cotton, trouble is sure to ensue. Wherever double carding is in operation, the common custom is to set apart a certain number of cards to each lap doubler, for the purpose of using on such cards picker laps made entirely of waste, thereby thoroughly mixing such waste throughout the lap as taken from the doubler, and by the time it passes through the railway head and drawing frames obtain a most even mixture; but, where single carding is in use, then the custom is as stated before — to mix in the picker room. As the honesty of the mixing at that point depends entirely upon the faithfulness of the employees in that department, it cannot always be depended upon for thoroughness, and in consequence we do not get as good results as when mixed or used on double carding systems. Not only is this true, but we find the same principle in regard to picker lap waste, made in picker and card rooms. This class of waste may become a source of trouble from putting too much of it through pickers in one lot, without thoroughly mixing with raw cotton.

That our Continental and foreign manufacturers are to be congratulated an the strict attention they give to mixings of all kinds, I submit the following extract from a foreign paper, showing the attention paid to a class of reworked lap waste, that but few of us in this country take much heed of:

"Lap waste is the remnant or the torn ends from good laps. These are usually returned and put behind the openers with the unopened cotton. The disadvantages of this practice are not many and serious, but this mixing is not to be recommended when a large heap of the lap ends is put behind the opener without being mixed well with the other cotton. This neglect of a careless feeder produces soft places in the

rovings and causes serious trouble at times by the frequent breakages it causes in the card slivers and frames. The best way for the proper use of this waste is to take it back to the mixing room after its proper weight is entered in a book. It should then be laid over whilst preparing a new mixture in one or two thin layers to ensure its proper distribution. The weight would serve as a healthy check on carelessness and neglect. The principle causes of this lap waste are the irregular working of the knocking off motions at the finisher scutchers, the bad state of the lap rods, bad piecing at the back of the card, and last but not the least important cause is the over-abundance of the stock of laps. The irregular working of the knocking off motion, besides its many other minor evils, gives irregular lengths of laps which have to be sent back in case of an excess or deficit in the weight fixed by the carder. The conical form of laps caused by irregular or reduced draught causes a good deal of waste whilst the laps are being unfolded at the cards. In some mills the lap rods are inserted after the laps are knocked off the machines. This practice causes a good deal of waste by the rod pushing away lumps or bits off the lap at the other end from the core of the lap. This not only makes an uneven finish of the laps, but the longer piece of the side that was torn off has to be taken away and thrown in the waste to make an even piecing with the new lap. The best way to avoid this mischief is to put the lap rod in the hollow lap roller of the machine before the lap is knocked off. This makes a very decent tail end of a good lap. All lap rods should be pointed at one end and not formed with blunt round edges as are to be found in some slovenly managed mills. The next check against this kind of waste lies with the persons who put in a new lap at the finish of an old one. These people without any hesitation take off a half or a quarter yard at the finish of a lap, putting it into waste, and commence piecing up a new lap. This is particularly done by a can-minder to avoid the running off of a lap which would cause waste of the card web and the sliver at the front. I do not mean to say that all laps should be strictly pieced up at the finish of the one previous to it. This would undoubtedly cause some delay, but what is wanted is to check the practice as much as possible. Lastly, the over-abundance of laps contributes also greatly towards the accumulation of this waste. By having too many spare laps you will have to let them stand long, which causes a swelling or bulging out of the lap bottom either in the blow room or card room. It is, therefore, advisable to produce laps according to requirements, keeping only a few spare ones."

My own personal opinion is this, that all lap waste ought to be worked into a lap by itself, without being mixed with raw cotton, and passed through but just enough picking machinery to even it and prepare it in lap for carding; then such laps be put on cards, and the slivers mixed in with those back of railway head or coarse drawing frames in proper proportion. I think also that all waste, which has been carded once, like the best strippings, fly, card can, drawing and roving waste, and clearer waste should be worked entirely independent of being mixed with raw cotton. It does not seem to be a necessity to repick, or to put through carding again. Some kind of a machine with an apron and drawing rolls controlled by a sensitive evener, and a delivery on to the apron controlled in similar way that woolen cards are fed automatically (the machine to have coiler can system), the sliver produced from such machine to be taken to the back of the drawing frames can be used. My reason for this system would be to obviate the disposition, now existing in picker rooms, to not thoroughly distribute this class of waste with unworked cotton into openers; also, that there is in many mills too much card can and drawing waste sent back to picker, through carelessness of drawing frame and slubber tenders in making an over amount of can waste. Where light or heavy sliver is to be removed from can for any reason, a great many more yards are ordinarily removed than is necessary; also, that the slubber tender is too often prone to empty out of a nearly discharged can the few yards in bottom by turning it out and putting it into waste can. Whenever the percentage of this class of waste is above a certain amount, surely it cannot and will not work well when mixed with unworked cotton. It is true, however, that it is far better to have the operative remove too much sliver when single has been made than too little.

With the systems above described, the idea would be to work such cotton as was taken from the bale through without any mixing of waste stock of any nature, believing that such working would give the very best results, and as even yarn as is possible to obtain with our present imperfect system of picking and carding.

Some mills have machinery to break up broken cop filling and ring filling waste. There is some doubt in many manufacturers' minds as to whether this is economical, but others assert that it does warrant reworking rather than selling as cop waste. This is possible where it can be put into goods that do not call for especially even yarns, but it is a mistake to try to rework it in mixtures with raw cotton. It ought to be mixed with drawing and card can waste, and then worked as stated above. Oily card and clean, soft waste, either clean or dirty, may be worked up to good advantage with special machinery. Our Continental friends are specialists in this latter process, and today our very low grades of waste are imported into Germany, England and Russia, to be reworked into yarns and goods of a fairly commercial quality to demand a price far above the market price of the stock from which they are made, plus the cost of production. We, in this country, are in the background of manufacturing in regard to the proper and practical use of waste. Cotton waste as handled in the market (especially some kinds) is a drug, and commands low price; many of the uses to which it was formerly put, have been abandoned and something else substituted. By referring to the valuable article on reworking waste by Prof. C. P. BROOKS, in Vol. 61 of the Transactions of this Society, information will be obtained as to the manner of reworking low waste in foreign countries.

The question for any manufacturer to consider is whether under the circumstances the absolute removal of all kinds and classes of waste from his standard goods, the better quality of same to be obtained thereby, would not be of sufficient interest to have him invest in such few special machines as he would purchase to handle all his waste as a specialty, the yarns from which to be put into cones for sale, or to be worked up into other classes of goods that might be woven.

Of the waste made in mills, both soft and hard, the amount has been sensibly decreased by the improvements in machinery for the last 20 years. The substitution of the revolving top card, as compared with double carding, or even with heavy sin-

gle carding, or the Foss & Pevey type, shows a very marked decrease in card waste. The use of 12-inch cans for 10-inch on cards and drawing frames, the metallic roll on drawing frames, the working of larger bobbins on the intermediate and finer processes of roving machinery, larger bobbins on spinning and spooling, more length of yarn on warper and loom beams, ring filling for mule cops; all these have contributed each in their proportion. Much credit is due to what has been done in this line. Still we are not satisfied, and perhaps reasonably so, for, with all the improved machinery, with the best of stock, we sometimes feel that our waste account is something appalling. We must now treat with the operative to bring the loss of waste lower, if possible. How can this be done? Presumably, in all up-to-date managed mills, certain rules are understood to be enforced, made and intended to work to the end of economy in preventing the making of waste beyond the lowest legitimate or practical point. Whether these rules, if strictly adhered to, would or would not prove efficacious depends entirely upon all the parties concerned inside the mill. It has been stated, and it is undoubtedly true, that a too rigid enforcement of rules pertaining to this subject, does not produce the result sought for. More particularly true is this where cop filling is used in weave room; also on spoolers, slashers, etc. A good properly built cop, and a good properly built overseer are indispensable in a weaving plant, if a minimum amount of waste is to be found in weave rooms.

At a meeting of this Association some few years since, in fact, in 1896 at the Profile House, this question was discussed by quite a number of our members; various methods were described and suggestions made. It would seem that the consensus of opinion was to the point of impressing, first, upon the employees the monetary loss to the mills of every ounce of waste made, and that the responsibility should be borne not only by the operative, but by section men, fixers, second hands and overseers. Indeed, in this matter, superintendents and agents should be included. In point of fact too little attention is given to the

subject of waste. In nine cases out of ten, the waste house is not visited often enough. Oftentimes the boiler house is made a receptacle for waste of all kinds, perhaps in no great quantities at a time, but when computed for the six months means a good deal. Oily waste and dirty sweepings start a fire in boilers as easy as most any material, so firemen say. In these times of competition, not only with our neighbor at hand, but with others in adjoining states, it is an imperative duty to produce our goods of strictly first class quality, and of watching what might be considered the smaller things about the concern. In one sense, the boiler house, banks of the canals and rivers, mouth of sewers, and waste house, are nearly as important to look out for as is the handling and inspection of cloth in the cloth room; for in these places may be found generally the waste products of the mill, not only in yarn wastes, but also wastes in supplies of various kinds. The longer we, at the North, remain in the manufacturing business, the more and more must we have in mind the most rigid methods of economy, and certainly one of the places wherein improvement can be made is the thorough handling of the waste products of the mill, and prevention of excesses.

Is there any more important subject for discussion than this? First, the prevention of excessive waste. Second, the most practical utilization of it when made.

This article has been prepared simply to open up a discussion, which it is hoped will not be dropped, but be carried on at a future meeting. Mutual confidence and interchange of ideas was one of the prime factors that led to the establishment of this Association.

I think this subject will bear considerable thought. In discussing it, I have only limited myself to the ordinary cloth mill. It is of equal importance to the yarn mills, and to a greater degree to those managing colored mills, where the value of the waste is enhanced by additional expense in labor.

Through the many years this Association has existed, this subject has been indifferently discussed two or three times, and

even at those meetings the subject was of interest to all concerned. More and more, as time rolls on, will the handling of the waste products of the mill assume greater importance. We must face it sooner or later, and it is with this in view that I trust a full and free discussion may ensue. A vast amount of information might be obtained, were our members here present moved to give their experiences. It is rather a sad commentary on our skill as manufacturers when our waste is exported to foreign countries to the extent it is, to be manufactured by them into goods of so excellent a character. With the aid of improved and special machinery for lessening the amount made, reducing the amounts made by our employees, utilizing machinery for reworking, and the one important factor, that we are promised a very large decrease in the waste by using improved ginned and packed bales, we ought practically reduce this account to a percentage pleasing in its low amount and of benefit to our profits.

The members are referred to various articles prepared by our members, and others, particularly interested in the system of ginning and baling cotton; also, on discussions of waste, to the following volumes of the Transactions of this Association, viz:

Vols, 59, 61, 62, 64, 65, 66 and 67.

The PRESIDENT. The next paper is Latin American Trade in Cotton Fabrics by Mr. WILLIAM WHITTAM, Jr., of Woonsocket, R. I.

LATIN AMERICAN TRADE IN COTTON FABRICS.

WILLIAM WHITTAM, JR., Woonsocket, R. I.

Happily, at this time one cannot lay so much stress upon the immediate necessity for the expansion of trade in cotton fabrics in foreign markets owing to an apparent chronic state of stagnation in the domestic demand. You have however had your attention directed from time to time to the question of an enlarged outlet for the products of our mills, but an examination of our export statistics will demonstrate that we have not yet reached—scarcely approached in fact—the front rank of exporters of manufactures of cotton.

The rapidly increasing productive capacity of our southern neighbors, and the evident trend of many of their mills to turn their attention to the finer grades of fabrics will certainly at no distant date, force our manufacturing corporations to seriously take up this matter, if a healthy condition of trade is to be maintained. It has been computed that the south will add 2,000,000 to the number of spindles now in operation, during the current year, and should this rate of increase be maintained for another year or two, the result cannot but be most prejudiced to the industry throughout the country, if our own people only, are to be relied upon as extensively as has been done in the past, to consume practically the whole output.

We have in Latin America some 65,000,000 people, each individual being a potential customer for our products. Any detailed expert from governmental statistics would involve such a tedious multiplicity of figures that a general average has been taken from United States treasury department publications,

The Statesman's Year Book and the returns of The British Board of Trade and from these authorities I have deduced the following as the value of the markets of South and Central America and the West Indies; *First*, the average total value of the imports of cotton goods by these countries is approximately $79,200,000, this being the value of the goods in the countries of origin.

Assuming that these goods, averaging gray, white, colored and printed, cost six cents per yard and that they weigh five yards to the pound; let us see how many spindles could be kept in operation if this country could secure one-half of these markets. My friend Mr. D. A. TOMPKINS gives 79 pounds per spindle per annum as the average production for the mills of this country. This then would require 1,450,000 spindles, or very nearly as many spindles as were in operation in the southern states ten years ago. The value of our annual sales of cotton goods in these countries during the decade ending 1898 was only $4,650,000 and this amount is only a trifle over five per cent. of their total imports of cottons. This value was about equally divided between colored and uncolored cotton cloths. In other words we sold to Latin America rather less than six per cent. of their total purchases of manufactures of cotton.

Granting that such a market is desirable and may soon become absolutely essential to us, the question of how this trade may be reached cannot but be interesting and important to us as producers of cotton fabrics. A sufficiently exact knowledge of their requirements can only be obtained by careful study, on the ground, but the details of many samples of fabrics in large demand in the markets under consideration are given. These samples were collected in Venezuela, Columbia, Puerto Rico and Curacao and were all made in Europe, mostly in England.

Table 1 gives sufficient particulars to convey a general idea of the structure of the fabrics. The column headed "loss per cent." gives the loss in weight of each piece after the adulterants had been scoured out, the percentage given being on the gross weight of each sample. If the amount of size found in the gray sample had been shown in per cent. of the original weight of

the warp only, one would wonder how so little cotton could possibly be made to retain such a weight of sizing materials.

TABLE I.

Sample.	Color.	Sley.	Pick.	Width inches.	Yards per lb.	Loss Per cent	Marks, &c.
A	Blea.	76	76	33	4.99	28.6	Simpaties blanco de algodon.
B	"	72	72	33	5.93	15.4	" " " "
C	"	68	60	31½	6.02	18.8	O. B. y Cia.
D	"	64	64	35	5.59	20.4	La Aurora.
E	"	72	68	33	5.77	15.2	Simpatico { American Cotton. Manchester manufacture.
F	"	60	60	30	7.74	22.8	Fonografo.
G	Grey.	80	36	29½	2.25	12.0	Loneta
H	"	80	36	29½	2.84	37.8	Loneta cruda.
I	"	32	40	23½	3.15	42 4	Liencillo crudo
J	"	68	48	28	2.58	41.4	" "
K	"	68	68	27	4.15	37.7	" "
L	"	76	44	24	3.78	61.5	Loneta cruda.
M	"	30	36	29½	2.68	—	

Table 2 gives similar details on another lot of samples, but these were not scoured, therefore the per cent. of size is not given.

TABLE II.

Sample No.	Color, &c.	Sley.	Pick.	Width inches.	Yards per lb.		Lengths.
1	Bleached.	72	72	33	5.13		
2	"	64	72	34	5.		81½ yds.
3	"	72	80	35	5.1	Most in demand in white goods.	80 "
4	Half Bleached.	72	80	33	5.9	In good demand.	80 "
5	" "	76	68	29½	8.2		79 "
6	Bleached.	64	64	29½	4.86		
7	Grey.	64	40	23½	5.08		
8	Col. Shirting.	68	56	26	7.42		
9	Grey.	44	48	29	4.66		
10	"	40	36	24½	2.75		
11	"	80	50	26	2.96		
12	"	72	56	24½	3.85		
13	"	80	56	25½	4.5		40 "
14	Col. Stripe.	56	48	21	14.		70 "
15	Col. Check.	84	48	25	3.85		
16	Blue & Wh. Stripe.	72	36	26½	3.94		
17	Printed.	72	56	25	7.7		
18	Col. Check.	80	54	25	3.32		
19	Grey.	48	48	24	6.7	In very good demand.	
20	"	60	54	30½	4.07	In good demand.	
21	Pink & Wh. Stripe.	88	80	32	5.17	In very good demand.	

It is utterly foolish to have representatives who do not thoroughly understand the language of the country to which they are sent, and the more cosmopolitan the man, the greater will be his chances of success. A complete technical knowledge of all kinds of cotton fabrics is also quite as essential as his linguistic ability. He must also be a polished gentleman in manner. In this connection I must relate to you an experience of my own in one of the large commercial centers of South America.

While in the office of a very large German South American house, a young man came in who represented an American exporting firm. He could not speak a word of Spanish. Fortunately the representative whom he interviewed possessed a working knowledge of the English language; however he at once proceeded to show his samples. Some of his goods were desirable lines but when the customer talked of ordering hundreds of pieces, the salesman replied that they only had possibly 20 or 30 pieces of that pattern for sale, the consequence being that no business was done. Shortly afterwards the representative of a Manchester house was announced. He conversed with the principal in his native tongue (German) and with one of the clerks in Spanish, he was also the master of several other languages. I remember as a striking contrast to the lack of result attending the efforts of the American salesman that when the English representative showed one sample to his customer the latter remarked, "Mr. B., this fabric is too expensive; can you give me one something similar in appearance at such a price?" naming a figure rather lower than the one quoted; out came a pick glass, pencil, and note book and in a short time the seller answered in the affirmative. Briefly, before leaving, the man had secured orders amounting to about $200,000.00. Subsequently he (the salesman) informed me that on his return to Manchester he would personally buy these fabrics from the mills, have them finished and his house would then ship them to Hamburg for trans-shipment to South America, and that they would receive payment for the goods inside of two weeks from the date of shipment.

This brings to mind the fact that there are not in this country the facilities for transacting business in this way. Exporting merchants in dry goods as distinct from the purely commission houses, do not exist with us, nor have we any central exchange corresponding to those in Europe where the merchant can meet the manufacturer daily.

Technical education is making rapid progress with us, but we are as yet wofully lacking in the matter of commercial instruction, in so far as it is applicable to foreign markets. This will possibly remedy itself to some extent, in a practical way, by the experience we shall receive in the development of the markets of our recently acquired territories but that some institution for the training of young men who desire to enter the foreign commercial field, is both necessary and desirable is obvious; instruction in foreign monetary systems, rates of exchange, influences which directly and indirectly affect the trade of particular countries, foreign languages, custom tariffs and tariff regulations, weights and measures, ocean transportation companies and freights, interior transportation, with its concomitant the packing of goods to meet the conditions peculiar to each country; from the package made up so as to be readily borne on the head of the native carrier in Central Africa, to the bales strapped on the back of the patient burro of South America. The prevailing systems of exchange of commodities, and many other subjects equally important in the successful carrying on of foreign trade would be given in any properly organized system of commercial education.

A proper grounding in the matter of currency, or the monetary systems of the several countries, is quite important, there being no less than 15 different standards of value in the principal South American countries, some currencies being of fixed value, while others fluctuate with more or less frequency; there are also many peculiarities commonly in vogue, which can never be understood from what may be termed a "book" knowledge of the subject. Take for example Venezuela, whose monetary unit is the "Bolivar" having a fixed value of approximately 20

cents (American), equal to the French franc, and the Spanish peseta. While this is the unit, all transactions are invariably made in pesos of about 80 cents value, notwithstanding the fact that there is not a Venezuelan coin of this denomination.

Again the metre is the standard measure adopted by the government, yet all goods are invariably sold by the "vara", equal to 33.38 American inches. These instances of local variation from the legal standards are given in order to show the importance of an exact knowledge of local conditions and usages.

The climate, general characteristics and resources of any country have an important bearing on its trade. The people, both male and female of tropical and semi-tropical countries, are almost entirely cotton clad, cotton making the most suitable garments for both hygienic and economical reasons. With a generous soil, yielding easily and constantly valuable tropical products and sufficient food to supply the meager wants of the common people, an utter lack of knowledge of industrial systems and processes, together with an absence of local capital, initiative and enterprise being almost altogether unknown, the retardment of the development of manufacturing is easily understood. True there are several hundred cotton mills in Brazil, approximately a hundred in Mexico, and one or two in other South American countries. They are, however, engaged altogether in the production of coarse, heavy goods, and do not materially affect importation values. The rapid and apparently permanent decline in the price of coffee has materially diminished the purchasing power of Latin America. At least until the immense natural wealth there lying dormant is more largely developed and the exploitation of the wonderful mineral deposits scattered so lavishly throughout the continent, is more seriously taken up, they cannot hope to regain their past value as customers of manufacturing nations. Brazil, Mexico, The Argentine Republic and Chili have made great use of their natural resources and other republics will doubtless follow the example set them and ultimately become of even greater value commercially than at present. We, as producers of cotton goods, would first naturally

direct our attention to the requirements of the trade in this class of merchandise, once it has been decided that the markets are worth cultivating.

One important fact to remember is, that the bulk of the demand is for cheap and showy goods, and until we are not only prepared, but also willing to meet the demand, we cannot hope to meet with any considerable degree of success. The practice of heavily sizing the warps, in order to cheapen the prices at which goods can be sold will doubtless have to be adopted by the coarser mills who decide to compete. The ethical side of the question of adulteration does not concern us, so long as our customers know that the fabrics are adulterated, and I assure you that they do know this, quite as well as does the producer, and so familiar are they with the subject, that any attempt to foist such goods upon them as "pure size" expecting to receive for the extra adulterants the price of good cotton, would be fatal to the future chances of securing trade for any firm who should be so foolish as to make it. It is certainly a fact that the preference is for goods having the full appearance and "clothy feel", produced by heavy sizing. The lower prices of this grade are also practically necessary to the "peon" class.

In a conversation I had with several gentlemen engaged in South American trade, one gentleman, who is a member of a large firm engaged in the importation of dry goods, remarked that "while the sizing of cotton goods does not improve their wearing qualities if carried beyond a certain point, it certainly does add materially to the appearance of a fabric, imparting to it a 'clothy feel', a good cover and giving to the goods a 'body' that cannot be equaled in the unfilled fabrics; and when it is remembered that this process also enables both the manufacturer to produce and the merchant to sell them at much lower prices, you can see that if American manufacturers are really in earnest in their desire to sell us their manufactured articles, they must supply us with the goods we want. Indeed, Europeans appear to make it their constant study to acquire a more intimate knowledge of the habits and customs of our people, their tastes,

etc., and then to supply us with exactly the articles we require, not modified to suit their own convenience in making, or to meet their own ideas as to what they think we ought to want."

It is all very well for us to say that these people will in time learn that the pure goods are the cheapest in the end, and that they will ultimately become customers of ours because we do not make adulterated fabrics, but suppose for a moment that we educate them to the point of seeing "eye to eye" with us in this matter, how long would it take our European competitors to turn their attention to the manufacture of similar grades, and to drop the heavy sizing business?

I do not want to give you the impression that there is no demand for cloths of good quality, somewhat similar to our standard makes, for there is such a demand, which in the aggregate is of considerable volume. At the same time, it cannot be compared to the sales of the cheaper goods either in quantity or value. Some months ago, I scoured out the adulterants from about 20 samples of European makes of gray and white goods, all of which are practically standard fabrics in Latin American markets. I found that they lost from 12 to 61 per cent. on the whole weight. The "*sine qua non*" of the matter is that we must meet the wants of the buyer, with regard to price, weight, width, length, design, assortment and packing. Import duties are generally quite excessive and, in many of the countries, this is the source of about 90 per cent. of the total revenue of the governments, direct taxation being practically impossible under existing conditions. It will be obvious therefore that to purchase a piece of cotton cloth at retail, which would be considered cheap with us, is anything but a low-priced article when it reaches the consumer in any of the markets under consideration; in fact, duty, ocean freights, interior transportation charges, packing extras, and various profits and commissions will generally more than double and quite often treble the American retail price, and this to a man earning 40 or 50 cents a day, makes the question of cheap goods a matter of some consequence.

FIGURE 1.

VENEZUELAN "SHIPS OF THE DESERT" BRINGING COFFEE INTO THE CITY.

FIGURE 2.

FIGURE 3.

FIGURE 4. VEHICULAR TRANSPORTATION IN BRAZIL.

We are very much behind our competitors in many details, which might seem unimportant, but which in reality have much to do with successful competition; the marking of goods and pieces is a case in point. American goods are very generally marked in English, the marks being consequently quite unintelligible to the retailer and consumer. Trade marks should be in Spanish, and lengths and widths expressed in the terms of the standard in common use in the country to which they are sent, the "vara" (vara = yard) being the term generally employed. In ten countries there are no less then eight standard vara measures, ranging from 32.87 inches to 34 inches. It is customary with European merchants to mark each piece with the name of the importer, and occasionally some special trade mark of the importer is placed on the goods, a small extra charge being usually made to cover the actual expense of doing this work.

Invoices must be made out in Spanish and prices, etc., also expressed in terms of the monetary system of the country to which they are sent.

In many countries this is a requirement of the tariff law, and any failure of the exporter to comply exactly with this regulation, involves the payment of a heavy fine by the importer.

The proper packing of goods is a matter of first importance; duties are usually collected on gross weights, therefore everything possible should be done to lighten the weight of each bale, all unnecessary boards, stiff paper, binders, etc., being left out.

South America is generally very mountainous and comparatively without railroad facilities, and cart roads; interior transportation being generally done by means of donkeys over mere bridal paths through the mountains, wood cases being for this reason utterly impossible. Burlaps and waterproof paper are used entirely for covering, and each package should weigh about 150 pounds. Lack of proper docks, and landing by lighter through the surf is common and this in conjunction with frequent and serious delays and exposure of packages to a tropical sun and torrential rains on the wharves, and also during a lengthy journey into the

interior often taking several weeks for its accomplishment makes the necessity of a perfectly waterproof bundle paramount. As in the case of special marking, so with packing, it is usual to make a small extra charge, for specially packing goods for these markets. From $1.00 to $2.00 per bale is the amount usually debited for the extra cost of packing. Bales ought to contain an assortment of patterns, so as to permit of their being sent directly to the branch establishments of the importing house, or to the retailer in the interior without reassortment.

The photographs are reproduced in order to give some sort of an idea of the actual conditions existing in many South American countries.

No. 1 shows a train of donkeys loaded with coffee, coming into the city of Caracas, Venezuela. No. 2 gives an idea of the kind of country to be traversed and the mountains to be climbed in order to reach the interior. A railway will be noticed in this picture. No. 3 is another view of the same railroad, illustrating a mountain station and these two views give a general idea of the difficulties to be overcome in the construction of railroads in the mountainous districts, the expense involved being largely responsible for the very primitive transportation methods now existing in Central and South America. No. 4 gives a good representation of the kind of vehicular transportation obtaining in Brazil at the present time.

Extended credits are the rule, six months being the average time required and given; many interior merchants, even with this time allowed them, frequently pay for their goods before they come to hand, owing to slow transportation and the frequent delays already mentioned; after all, the matter of giving extended credits is merely a question of profit, and if European merchants find the trade profitable, prices, terms and risk being taken into consideration, and fight for it as keenly as they do, this feature cannot surely be an insurmountable obstacle to us; we are undoubtedly badly handicapped by the entire lack of direct banking facilities, almost every dollar we exchange, having to pass through London, and in its passage a bit is chipped from it;

the enormous annual tribute we thus pay to the London bankers could just as well be kept at home, if our banking capitalists were more enterprising than they have so far proved themselves to be.

The development of American ocean shipping has recently been much talked about. We are in a rather unenviable position in this respect, and the frequent complaints of our consuls in the matter of freight discrimination against American shippers will never be stopped, until our carrying trade is in our own hands. American cotton goods are generally, in the coarse and medium grades, of superior quality, but not of so generally nice an appearance and "feel" as compared with those made in England. Minor imperfections are of more frequent occurrence in our goods. This can probably be attributed to the fact that with us a weaver runs more looms than is customary in European mills and that the "cuts" in the latter establishments are subjected to more frequent and rigid inspection than is customary with us.

In Lancashire the weaver "picks" the cuts before they are taken to the cloth room, and they are there usually "counter" inspected by the "cloth looker", and again submitted to examination in the folding machine.

Competition in all foreign markets is most severe, and we cannot hope to capture a large proportion of such trade, except by persistent effort, and intelligent and close study of the several markets. Nor can the knowledge necessary to enable us to attain this admittedly desirable end be acquired at long range. If we do in the end win a position in the front rank of exporters of manufactures of cotton, it will only be by sheer merit, the trade will never come seeking us, of this we may rest assured.

The American capitalist has been in the past timid in the matter of foreign investments, in somewhat striking contrast to the British and German investor. Railroads, telegraph companies, banks, industrial, agricultural, and mining enterprises, owned by European capital are scattered throughout Latin America, and these have a great influence in directing the channels of commerce.

After all, the subject of our foreign commerce is frequently discussed in a free and easy way; just as if all we had to do was merely to intimate that we would like the trade, in order to wipe out European competition. While as a matter of fact each particular industry has to take up the study of the possibilities of its own expansion abroad, from every point of view, and if any condition or combination of conditions in the interior economy of an industry renders competition at equal or lower prices for equal grades of goods, impossible, then it would be simply a waste of money to try to sell under such circumstances. In our case, however, we can compete most effectually, as is proven by our greatly enlarged trade in recent years with the market of Mexico, our near neighbor, as well as with that of far away China.

European merchants engaged in South American trade are equipped with trained representatives who know the language and country intimately. They have also shipping departments admirably systemized and these departments are under the direction of men who are fully as conversant with the trade requirements of the several countries, so far as they relate to this department, as are the native importers themselves. Business connections of long standing quite often grow into close personal friendships, which obviously and properly may be counted as obstacles for the newcomer in the field to fight against.

In conclusion it can be said that in the two leading foreign countries where American cotton goods have been persistently pushed and earnest efforts made to meet market requirements, a somewhat satisfactory degree of success has been secured and with equally persistent efforts in other non-manufacturing countries a gratifying enlargement of the volume of our exports can be made, and the danger of overproduction and trade stagnation at home would be very materially diminished, and perhaps almost entirely obviated.

The PRESIDENT. The next paper is upon Southern Cotton Manufacturing by Mr. M. F. FOSTER of Milford, N. H.

SOUTHERN COTTON MANUFACTURING.

M. F. FOSTER, Milford, N. H.

The rise and progress of cotton manufacturing in the cotton producing states has been marked by the most rapid and the greatest growth of any industry in the history of the world. The early efforts made to manufacture cotton goods in the South met with signal failure and at the commencement of the civil war the business was considered of very little importance. The idea of cotton manufacturing in the South was coeval with the invention of the cotton gin. A cotton mill was incorporated in Georgia in 1798 but there is no authority to show that any organization under that charter was had. The first cotton mill in Georgia and perhaps in the South was built in 1811 on Upton Creek, nine miles southeast of Washington, Wilkes County. It was known as the "Bolton Factory". It was sixty feet in length by forty feet in width, having two stories and a basement and attic and built of brown stone with grey rock lintels over the doors and windows. Over the front door was inserted in the wall a large grey stone with the word "Bolton", the name of the architect, with the date "1811" beneath. The stone is now in the possession of Rev. FRANK T. SIMPSON, of Aonia, Wilkes County, Georgia, son of WILLIAM SIMPSON, who bought the property from the estate of General GREENE in 1835. The building was demolished in 1842 but the foundations are still to be seen. The factory was not a paying investment and after being operated for a few years it was closed and the machinery removed to a plantation and operated to furnish clothing for the slaves.

The writer in 1858 first engaged in cotton manufacturing in the South. That industry previous to that time had been looked upon in an unsatisfactory manner in most localities in that section of the country and failure followed failure and the opinion of many was that the business would not be a success anywhere south of Mason's and Dixon's line. White labor was unreliable and the experiment of working colored labor in the cotton mill had in most cases proved a failure. A few cotton mills had been fairly successful in their operations owing largely to the favorable conditions in the location of the mills and good business management.

There had been some good practical manufacturers that had found their way into the South and had introduced the right principles of successful manufacturing but the business as a rule was badly managed. I was there as overseer of carding in the Augusta Factory, Augusta, Ga. Upon looking over the situation I found some methods in use that were both new and novel to me. The traverse grinders had been laid aside and in their place was brought into use straight edges of wood, three by three inches and thirty-six inches long, one side of which was covered with emery and applied to the card by hand, one man holding one upon the cylinder at the rear of the card and another man applying one to the doffer. When these devices had been applied long enough in the judgment of the men using them they proceeded to set the card for work. The man at the cylinder set the top flats and feed rolls, and the man at the doffer set the doffer and comb. It was an enigma how to decide which of the two men should be held responsible for the good or bad work coming from the card when it was put to work. These straight edges were discarded at once and while traverse grinders were being put in condition for use, leather stricklers were substituted. The men using them, thinking them too light, ingeniously applied by the use of wire, iron to the stricklers, to cause them to grind faster. This invention it is useless to say, was ordered to be discontinued and in a short time the usual methods of card grinding were introduced. A no less

original plan for card grinding was in use in a mill in middle Georgia in those early days and consisted of a soft burned brick held by hand upon the card while running in a reversed direction. These were the harvest days for the manufacturers of card clothing which in later years has gone into decline on account of more improved methods of card grinding and stripping and by the introduction of steel wire in its manufacture.

In 1860 the writer made an engagement to go to Tennessee to superintend a small cotton mill which had become profitless to its owners. The mill when built was filled with machinery from the first builders in the country and had been in operation ten or twelve years and at the time mentioned was literally worn out. The journals to the rollers on the pickers were worn to the diameter of less than three-quarters of an inch in some cases and other working parts of the machine were in equally bad condition. The cards were a curiosity. Originally they were constructed without lickerins; card grinding had been almost entirely done away with, and the proprietor in his ignorance of the business sought advice from every tramp workman that came along. One man told him what was wanted was lickerins on the cards and explained how they could be applied. His services were engaged to make the so-called improvements and he went to work to remodel the cards. He obtained some pine logs none too well seasoned, cut them into the required lengths, drove iron bearings into the ends, turned them off, devised means for applying them to the rear of the cards, using the same feed rolls and stands that were on the cards before the change and leaving an open space below the so-called lickerins. To prevent cotton from flying about the room a box was constructed after the dry goods box plan, and placed under the lickerins to catch the cotton which was freely thrown off from that appliance. It is useless to say that the results were not satisfactory.

In the same mill the studs to the intermediate gears between the front and calendar rolls on the railway heads and drawing frames became worn out and the gears were discarded and a

leather strap substituted, which was applied by running it on the ends of the teeth on the gears of the front and calendar rolls. This method was not as positive a drive as the gear, yet it served the purpose. The same spirit of economy in repairs extended further on in the mill and showed itself in a marked degree upon the spinning frames where the loose pulleys were dispensed with after becoming badly worn and every time a frame was stopped the belt was dropped from the tight pulley to the shaft. This made it lively for the card room hands in the room below whenever the frames were ready to start, as the spinners, either with roller clearer or bobbin rapped vigorously at the belt holes in the floor for the hands below to run their belts upon the shafting pulleys. The prospect was not encouraging for a superintendent and my engagement soon ended at that mill. I have no knowledge of what the end was at that mill, but think it came soon after.

The labor question was in those early days of cotton manufacturing in the South a great problem to be solved. The material for mill operatives was in a crude state resulting from slavery times. The white man looked to the negro to perform all kinds of manual labor and to come down to what he considered the level of the negro by subjecting himself to the proper discipline required in operating a cotton mill was not acceptable to him and only the results of the civil war brought him under the control of the manager. The men wore long hair and to keep it in place they wore old wool hats which soon became covered with cotton. The women, to conceal their uncombed hair, wore sun bonnets which covered their heads and faces. In time these head coverings were laid aside when the men had their hair cut and the women combed their heads.

The excessive use of tobacco by both sexes and the uncleanly habit of freely spitting upon the floor caused an accumulation of filth when mixed with cotton and dirt of the mill that could only be removed with a shovel. The operatives stayed from the mill at their pleasure and it was doubtful if on any morning a sufficient number reported for work, and to be able to keep the

BOLTON FACTORY, THE FIRST COTTON MILL IN GEORGIA.

From a Sketch by Rev. F. T. Simpson.

machinery running it became necessary to send out to the houses and upon the street to drum in recruits. The conditions brought about by the war changed that state of things. All able bodied men were conscripted and those wanted for cotton mills were detailed for that work. The instruction given was that when the men were no longer wanted for that work they should be turned over to the nearest conscript office. Most of the men employed in the cotton mill did not want to be soldiers and the fear of being enrolled into service prompted them to subject to the proper discipline and at the close of the war labor was well organized and in condition to operate the mills successfully. It was then that cotton manufacturing began to be a profitable business in the south and the few mills which survived the war and were under good management made great dividends to the stockholders. The success of these mills stimulated the investment of capital in the business, and new mills rapidly increased in the neighborhood of those which had been the most successful. The mill operative had come out of his unpolished state by his surroundings in and out of the mill. Most manufacturing places in the South now have schools and churches supported largely by owners of the cotton mills. Libraries and places of amusement are also put within the reach of the operatives and it can be said that a considerable part of the cotton mills south have as competent and well trained operatives as can be found anywhere.

In looking upon the rise and progress of cotton manufacturing in the South we are lead to believe that the coarser fabrics of cotton goods will be manufactured there, the only doubtful issue that ever presented itself having been the labor question. But that long since has ceased to be a cause of apprehension. While the question of cheap labor and longer hours for a day's work in some localities in the South gives considerable weight to the matter, yet, in fact, it does not enter much into the future prospects in favor of the southern cotton mill. The labor element when of sufficient strength will not fail to secure for themselves all the rights and privileges which have been obtained

through legislation in the New England states. It will probably be many years before the same adverse legislation will be inaugurated South that is being forced upon the manufacturers in New England, as there are other and more diversified interests that will absorb and divert their attention from the mill operative. The small farmers in the South are removing to the manufacturing places where they can better support their families. They go to the cotton mills to stay.

The necessities of life for the southern mill operative are less than for the New England mill operative, cheaper rent, fuel and provisions enter largely into the matter of living, together with the fact that the southern mill operative seldon provides for the future. His present wants are first and foremost. The scale of wages will be regulated much upon the basis of the operative's wants and the supply. The South has a climate well adapted to cotton manufacturing where nine months in the year work is conducted without artificial heat and with open doors and windows. The southern manufacturer has his cotton laid down at the factory with no short weight from cotton pilferers or from any other shrinking process so familiar to those who handle the cotton crop. The increasing railroad facilities of transit to the great markets of the United States and foreign ports give the South low rates for freight and places the southern manufacturer as a competitor with any other manufacturer in the United States.

The history of cotton manufacturing throughout the world is traceable in its progress from the coarser to the finer product of the spindle and loom. The coarser fabric with its wealth of staple will find its producer nearer the cotton fields and under a milder sky than can be found on the ice bound streams of New England. The finer grades of yarn will follow closely upon the coarser grades and the South will become a sharp competitor with New England in the manufacture of those goods. The mistakes that have been made in building small mills operated with limited capital will not be repeated so much in the future, but the larger and well equipped cotton mill with ample capital

will become the future mill of the South. The New England manufacturer will not be slow to protect his business and will change the product of his machinery to the finer and more improved grades of goods and thus hold on to his business and realize profit to his investment.

The southern manufacturer has to learn before he becomes convinced that it is the favorable conditions that surround him that makes his business a success and not altogether in his ability as a manufacturer. As the conditions change and the margin of profits decreases, he will be lead to look about him and learn to practice greater economy in conducting the details of his business. While there are many mills in the South where the best of management has been introduced, there are others that are managed in the most primitive manner by men having the control who have picked up the limited knowledge they have of the business from second and third rate men who happened from time to time to be in their employ, and in many cases been dismissed for cheaper men. There are many small mills in the South that cannot under the best management be operated successfully in comparison with the better equipped mills controlling better skilled labor. It will only be a question of time when these mills will be closed. They will not survive legislation for shorter hours of labor and other restrictions that will be forced upon them by labor demands. The quality of their product will meet with greater criticism from the dealer and consumer which will either throw their goods out of the market or result in such a mark down in price as to leave no profit to the manufacturer. The larger mills backed up by ample capital will continue to compete with the best mills in the country with continued prosperity and aid in building up the new South. The introduction of cotton manufacturing in the South has done more to improve the condition of the poorer class of white people than any other movement that has visited them. They have been provided with better homes, better clothing and greater advantages in the way of schools and churches. They are fast becoming skilled in the work and management of cotton

mills. In the future they will have charge of the manufacturing part of the business and pose as overseers and superintendents. Growing up in the southern cotton mills they will know the country and the people. Less friction will arise between the management and the operatives, as they will understand each other better than when the foreign overseer and superintendent went among them and attempted to manage and control them in accordance with the customs of other sections of the country or from abroad. The New England man when he went South often made himself generally obnoxious by telling the operatives and others how they did things up North.

The foreign manager was only tolerated because he seemed indispensable to the success of the business, and a change of men was often promptly made when some native born man came along who had sufficient knowledge of the business to fill the bill. The bobbin boy of thirty years ago has become the overseer and superintendent, and in many instances is filling these positions in a satisfactory manner. The South has the material in men and brains and force to conduct every branch of cotton manufacturing from the common operative up to the president, and the New England man need not suppose that his services are required as a necessity to operate a southern cotton mill.

The South without question has become a competitor with the North in the manufacture of the common grades of cotton goods, and this competition will grow in years to come and the New England manufacturer will be forced to put his best foot forward to keep up in the race.

The question of using colored operatives in southern cotton mills is yet unsolved. There are a great number of colored men and women that are practically unemployed in the South that seem to be waiting for something to turn up. They crowd the towns and cities poverty stricken, and ever alert for small jobs at any compensation that may be paid them. In the country they are a menace to sparsely settled districts and forage upon hen coop and pigsty and are a terror to the white population.

They must go or choose some honest employment. If the way is open to them they will try the cotton mill, and it is among the possibilities that they will become an important factor in solving the labor question for southern cotton mills in years to come. At any rate they are there with sinewy arms and constitutions adapted to that climate. That they are capable of performing the work of the cotton mill operative there is little doubt, as has been demonstrated in those cotton mills which have given them a trial. The white man and the negro will not work alongside. They do not affiliate and will not be together in any labor organization. Those mills that employ colored labor can work nothing else. When the supply of native white labor becomes exhausted in the South the manufacturers will not hesitate to fill their mills with colored operatives which will readily be secured at low wages and be used to advantage in the manufacture of the common grades of cotton goods. If the negro has what the white man wants and must have, the white man will be sure to get it and use it.

It is not generally known but it is nevertheless a fact that before the civil war the cotton mill at Shelbyville, Tenn., made the largest return on the capital invested of any southern cotton mill, and it was worked entirely by colored labor with the exception of the superintendent.

The Vesta Cotton Mill of Charleston, S. C., contains 28,000 spindles and 736 looms and on February 27th, 1900, was operating 14,000 spindles and 450 looms on number 14, making three yard 4/4 sheeting and employing 375 negro operatives, three-fourths of whom were well trained mill hands and the balance were learners. The mill promises to be a success in the matter of working colored operatives. The mill was cleanly in appearance showing good management. The tidy appearance of the operatives compared favorably with a large percentage of mill hands either North or South.

The last decade has been the most marked in the growth of cotton manufacturing in the cotton growing states. From an investment of capital in 1890 we find less than $62,000,000,

while at this time, ten years later, we find over $124,000,000 invested in the business, showing that it has more than doubled in ten years so far as the investment of capital represents, and the gain in spindles and looms is much greater, having trebled in number, showing a total of over five million spindles. The southern cotton miils now consume in manufacturing about one-eighth of the entire crop of cotton produced in the United States.

In 1870 I prepared and sent to the Legislature of South Carolina a petition for exempting cotton mills from taxation, which became a law so far as new mills were concerned. The legislature was then composed of fifty negroes or mulattoes and thirteen white men. Less than 100,000 spindles were then in operation in that state. The spindles now running in South Carolina exceed one million three hundred thousand. During the months of January and February of the present year there was chartered in South Carolina twenty cotton mill companies with a capitalization of $3,025,000.

North and South Carolina cotton mills are rapidly increasing to a point where they will consume the entire cotton crop in those states. Georgia and Alabama will follow close in the same direction and in the near future the New England manufacturer will obtain his cotton west of the Mississippi river, which will also be the source of the cotton supply for foreign countries. Even that territory is threatened with cotton mills and in time will become a strong competitor with any other section of the country in cotton manufacturing.

The PRESIDENT. The next in order is topical question 119:

119. To which class of machinery, as at present running, is it desirable to improve the most to obtain a minimum cost in manufacturing?

The PRESIDENT. If there is no discussion, we will submit topical question 120:

120. English practice has been in the direction of separating the business of spinning from that of weaving. What are the advantages of this separation? Is there any such tendency discernible in American practice at the present time?

The PRESIDENT. As there does not appear to be any desire to discuss this at the present time, it will lie over until another meeting.

As the time for adjournment has arrived, this session stands adjourned until two o'clock.

SECOND SESSION

WEDNESDAY AFTERNOON, APRIL 25, 1900.

The Association met in Chipman Hall at 2 P. M., President THOMPSON in the chair.

The PRESIDENT. The first subject, A Critical Moment in the History of Export Trade in Cotton Manufactures, is by Dr. WILLIAM P. WILSON of Philadelphia. Dr. WILSON recently met with an accident to his throat which makes it difficult for him to speak, and it will be a matter of great accommodation to him and doubtless of pleasure to you if you will all kindly come forward and take the front seats. It will please Dr. WILSON and make it very much easier for him and enable you to understand the matter more clearly.

Dr. WILLIAM P. WILSON. Mr. President, members of the New England Cotton Manufacturers' Association: It is almost impossible, gentlemen, for me to speak to you today on account of an accident which happened within ten days to my throat, something which might happen to you in the same way. It seems as though I had a cold, but I had the unfortunate circumstance happen of getting a bristle from a tooth brush in one of the glands of my throat, and it has given me much trouble. I have not had the opportunity to get it attended to properly.

I want to state first that the small pamphlet which is being circulated among you is the basis on which I shall make a few

remarks. This pamphlet the Bureau of Information of the Commercial Museum of Philadelphia has taken great care in preparing, in securing the latest statistics of the production of raw cotton from all countries in the world, in securing the latest statistics of the manufacture of cotton in those countries and its distribution. I have put it up in the form in which you see it that you may slip it in your side pocket and have it for a little study. There is a good deal in it, I think you will find, as you look it over.

A CRITICAL MOMENT IN THE HISTORY OF EXPORT TRADE IN COTTON MANUFACTURES.

DR. WM. P. WILSON, Director of the Philadelphia Commercial Museum.

In a way, gentlemen, it savors strongly of "carrying coals to Newcastle", to urge upon the New England cotton manufacturers the claims of the foreign cotton export trade. For one of the first facts disclosed by a close study of our foreign trade relations in times past, is the gratifying circumstances that Boston exporters have, for many years held control over certain markets in Asia and Africa. For it is no uncommon incident to discover in the British Consular reports written with the hope of stirring English manufacturers to renewed effort, a statement that Boston now controls the trade in cotton goods in some territory ruled by British officials, and under the British flag; and yet, taking a broader view of the subject, the very fact that Boston has thus proved her ability to meet, on equal terms, the most powerful trading nation of the world, and upon such equal terms, won an unqualified victory, lends additional importance to the latest summary of the world's situation in the manufacture of cotton. In this summary, the United States, as a whole, cuts but a sorry figure.

Gentlemen, it is simply amazing to find that the United States, which raises the commercial cotton of the world, the United States known far and wide as the mother land of inventive genius, the United States blessed with the finest body of skilled labor the world can show, stands fifth on the list of exporting nations and below the little inland republic of Switzerland in her cotton export.

Think for a moment, what the following figures mean. The ten great exporting nations of the world shipped over their borders last year, manufactures of cotton having an aggregate value in excess of $500,000,000. Out of this tremendous total, one small shire in one small section of the United Kingdom of Great Britain and Ireland, with a population of only 4,000,000, supplied 66 per cent. of this trade; while the United States, with 80,000,000 people, the *world's cotton fields*, and the *world's best and largest body of skilled labor*, secured less than five per cent. Turn these percentages into actual figures. They show the world's trade $500,000,000; England's share, $328,000,000; our share, $23,000,000.

Surely these figures demonstrate beyond question the existence of conditions in the foreign trade situation which even the most optimistic American must consider worthy of serious attention; worthy of prompt, energetic, and intelligent effort, to modify and improve. For it is scarcely possible that anyone will argue that our home market can in the future be relied upon to consume our home production. With us all, I am sure, it is simply a question of our ability to *win these* foreign markets, and to *hold them against* the increasing volume and vigor of foreign competition.

On this question of ability to win and hold foreign markets I ask you to listen, for a moment, to words written by Mr. HAYES SADDLER, British Consul General, in a report on the trade, commerce, and navigation of the Somali Coast Protectorate, a little country on the shores of Africa, a report received at the foreign office as recently as January 30, 1900, Surely in this out-of-the-way country, and in the commercial conditions there prevailing, our ability to compete with British and other foreign trading nations is put to a supreme test; and yet, this is what "our friend the enemy", the British Consul, has to say about American competition.

"What stands in the way of a rapid extension of the trade in European white longcloth is the preference shown for the cheaper American grey shirting which forms the ordinary wearing apparel of the Somali

Island, and in which the chief trade in piece-goods with the interior of the country is done. White longcloth is looked upon more or less as a luxury, and its use is chiefly confined to the townspeople."

"At Zalia there is an increase for the past year in American grey shirting of 3,783,890 yards in quantity and of 412,782 rs. (rupees) in value. The Berbera returns show a decrease of 48,884 yards in quantity and of 55,777 rs. (rupees) in value; whilst there is an increase at Bulhar of 310,920 yards in quantity and of 24,036 rs. (rupees) in value.

"Since 1896-97 the total imports in this commodity have increased from 8,741,273 yards, valued at 1,664,983 rs. (rupees), to 14,057,980 yards of a value of 2,042,465 rs. (rupees)."

"It may be well asked why does all this business go to America, and why do not British manufacturers compete? The trade is worth now £136,000 about ($680,000), and if we keep the Harrar trade it will increase, as the resources of the Protectorate, and especially of Abyssinia are developed. American grey shirting is the ordinary dress of the native in this part of Africa, when not attired in his holiday garments in the towns, and here it easily holds the field. The quantity imported is 15 times that of European white longcloth. There is the whole of the Protectorate, and tracks to the east of it, the Ogaden and the country to the south, the southern portions of Abyssinia, and the Galla country, all to be supplied with this commodity, now an ordinary requirement of life. Would it not be worth while to compete for this trade? The Americans have managed to hit off exactly the requirements of the people; surely British manufacturers could do the same and open up an industry which will have a large future before it. What is wanted is a strong, durable piece, suited for rough wear, which will compete in price and quality with the American article."

I give you this point to show that where our people have sought to get into the market they have simply taken it and taken it away from previous occupants.

The tribute of the British official is very flattering to our national pride. More especially as Africa now bulks largely in the public eye, and promises, after the conclusion of the present war, to play a most important part in the world's commercial history.

But, gentlemen, when we journey a little to the north, and study the conditions of trade at the gateway of Africa,—in Egypt, a very different picture meets our eyes—a picture

which forces serious thought. For here, in Egypt, under conditions equally favorable and under the same flag of Britain, we find American imports of cotton piece goods showing the miserable total of 102,581 yards, with a value of $5,217, whereas Great Britain, beaten by us so easily in the market adjoining Egypt, shows a magnificent record of exports to Egypt during 1899 of 165,080,500 yards, valued at $7,146,825. This last market, if we had looked for it, would have been just as easily secured as the other.

Surely this incident shows neglected opportunities, and a strange and un-American disregard of natural advantages and highly cultivated facilities. For this preponderance of British trade in Egypt cannot be the mere incident of an accident.

The same pregnant illustrations are presented in other parts of the world; at one port, we lead the world, and at another with equally favorable conditions, we practically have no position in the race. And when success does occur, it is invariably due to the enterprise, energy and intelligence of some individual, seldom if ever the fruit of concerted action, along carefully conceived lines of commercial policy.

Indeed, our successes, equally with our failures, bear witness to our lack of system in attack upon foreign markets; and both unite to enforce the necessity of co-operation among American manufacturers and exporters, and a systematic study of market conditions, peculiarities, and the prevailing temper of local taste.

Australasia is also worthy of study by all interested in manufactures of cotton, for here opens an immense market for our goods under the most favorable conditions, both as regards sentiment in our favor, and facilities of commercial intercourse. How do the figures stand in this part of the world?

Great Britain, which meets us on equal tariff terms, also on equal transportation terms, in 1899 sent to Australasia 164,888,200 yards of cotton piece goods, valued at $11,669,749. The United States exported to the same countries, during the same period, cotton piece goods to the extent of 2,427,900 yards, valued at $216,384. The contrast offered by these figures

requires no comment. They but emphasize the lesson suggested in the statistics given in the figures concerning Egypt.

A new influence, which promises to affect our trade relations with both Egypt and Australasia, threatens to develop as a result of the war in South Africa. For one effect of this war is certain to be a drawing together of the widely separated localities which form the British Empire. Service in the field is likely to breed that feeling which holds our own states in such close fellowship. We must, as a trading nation, be prepared to meet a very strong sentiment in all parts of the British Empire, in favor of purchasing necessary supplies, whenever possible, within the Empire. The "commercial" community of interest has not as yet developed to a point where our trade is hampered; but the prospect of such conditions in the near future should stimulate us to renewed effort in the present.

We do not fully realize, I fear, the immense increase which has recently taken place in our facilities of production. We do not estimate, at its full value, the effect of those wonderful economies in production which a series of lean years has forced the American manufacturer to cultivate and put in practice.

Moreover, our working men, stimulated by the memory of limited employment and reduced wages, when the good times came again, flung into the commercial battle with startling energy. At the first call of increasing demand, the output increased by leaps and bounds. New factories sprang up on all sides, while old factories surpassed all previous records in their production. Only one result can possibly follow such a sudden awakening of activity — overproduction. To devote all our energies to the task of increasing production, without, at the same time, cultivating new markets, is as foolish as the oft quoted feat of the man trying to lift himself by his own suspenders.

Foreign trade is not an academic question to be discussed in dilettante fashion over the after-dinner cigar and when nothing of real importance occupies our time and attention. It is rather a pressing and immediate necessity. We can make, but can we sell what we have made? Yet upon our ability to sell what we

have made and *shall* make, rests our ability to continue a great producing nation. For our working classes, to develop their full ability, must be contented. In our American conditions, in our American climatic environment, the contented worker must be the busy worker. He draws in energy with the very air he breaths. His whole environment is intact with ambition. On every side, in all of his relations to life, there is constant contact with the spirit of ambition. It is outside of his temperament to remain quiet and at the same time content.

The hum of your many whirring spindles is today a song of triumph; but this music is apt, if we keep too near the surface of things commercial, and economic, to develop into a song of the Siren. Financial conditions, the temper of public opinion, and the whole drift of legislative sentiment *now stand committed to an active foreign trade propaganda.* At no time in the past have so many elements, virile and far-reaching in their character, stood behind the American manufacturer desirous of winning foreign trade. Let us *not* show to the world another example of a people intoxicated by success in the present, and so busy with contemplating victories in the past, that we can give no thought to the future, and take no advantage of the current when it serves.

I have refrained from adducing in my remarks a mass of statistical testimony to the wonderful extent of foreign export trade of manufactured cotton, and the meagre portion of that trade secured by the United States, but I permit myself to offer you these statistics and the logical deductions to be drawn therefrom in another form, which, published by the Institution of which I have the honor to be Director, I have the pleasure of laying before you individually, and offering you as an exhibit, as it were, to the general remarks, to which you have been good enough to listen, and as an addendum to be printed, if your worthy committee see fit, in your Transactions.

A study of these statistics, I can, with all due modesty, most heartily commend to every American interested in the manufacture of cotton. They show that the opportunity exists for

America to climb from her present subordinate position to the top of the ladder. With you, then, gentlemen, it lies whether that opportunity shall be taken advantage of to its fullest extent.

I want to make one remark here in conclusion, that during the past year the Philadelphia Commercial Museum has received from Congress a grant of $50,000 for going out into the manufacturing countries of the world and securing samples of textiles and all lines of manufacture which are in the open markets of the world in foreign countries competing with you. This appropriation of $50,000 has been used and $30,000 more with it, and over $30,000 of that was spent in the line of goods which you are manufacturing. We have been since the exposition in Philadelphia, as well as before, constantly receiving those goods, and we have now, with very much information concerning the foreign trade, a very large line of such samples of cotton and other textiles as are found in all the leading markets of the world. And I want to invite you cordially to make use of these samples. They are free at your disposal. You might think that they would quickly become antiquated in many ways, the prices lapse and all that sort of thing. I want to state that we are sending these samples over constantly to England, to France, to Germany and to Switzerland for re-pricing, and just before I left my home I received in return a sample lot, the samples all of which we had had in our hands not six months, but re-priced to date, of something like 500 new samples, and we are doing that every week. We have the facility through the leading commission houses of these foreign countries of getting the samples re-priced at any moment, so that those goods which are staple do not become antiquated. I invite you, then, to make free use of whatever facilities we may have. We have come before Congress again this year asking for a small appropriation to complete these samples. We found that although Congress gave us $50,000, and we have spent about $30,000 more, this was still insufficient, and I have every reason to believe that within the next two or three weeks both the Senate and the House will consider this bill favorably and we shall send experts abroad to

secure information and complete these samples. I thank you for your attention. [Applause.]

The PRESIDENT. The next paper is Belting: From Hide to Pulleys, by Mr. J. H. BURGHARDT of Boston, Mass.

BELTING: FROM HIDE TO PULLEYS.

J. H. BURGHARDT, Boston, Mass.

Having been asked to give to this convention a few facts in regard to the manufacture of belting, which have come to my knowledge I desire to say that in the manufacture of the best goods in this line, it is essential in this, as in many other lines that care be taken in the early stages of material. Very few realize how much care is required in bringing out leather best adapted to this purpose. The selection of hides which is considered the best at this time, is what is called the packers steer, taken from an animal from three and a half to five years old, in good condition, in order that the best results may be attained. An ox hide is liable to be a little coarser grain, and is not so well adapted to belting purposes. The cow hide is not adapted to this use at all, the flanks being too light for the back. A bull's hide is not suitable for belting, as the center part of the hide is too light, while the outer sides from the center are too heavy. A steer's hide is uniform in thickness, and is the very best stock that can be used.

It has been found that there is but little strength to the grain of a hide, as most of the strength is from the flesh side, hence there should be as little cut from the flesh part of the hide in currying, as possible. Very few users of belting are aware of the trouble belt makers have to contend with in the matter of hides, and great care should be taken when removing the hide from the animal on account of cuts, of which the manufacturers complain.

On entering the tannery, the first thing is to properly prepare

the hide for what we term the beam house, where the hide is soaked, and the flesh removed, preparatory to being treated with lime, to remove the hair and grease. In preparing the hide for the lime it should be, as near as possible, in the same condition as it was when taken from the animal, and great care should be exercised in handling it. To give you an idea, we might compare it to a piece of honeycomb. If you break one of the cells the honey will run out, and it is exactly the same with a hide, for if one of the cells are broken, the gelatine comes out. After removing the hair and grease from the hide, the lime must be thoroughly extracted, otherwise a coarse brittle piece of leather will be produced. After this the hide should enter a very weak liquor, which consists of a small proportion of tannic acid, and a large proportion of gallic acid. Then it must be fed with stronger liquors, from time to time as it needs it, in order to develop it to the stage it should be. It takes from five and a half to six months to properly tan belting leather, before it is ready for the market. Afterwards it takes two or three weeks to work this through the currying shop in proper shape, and about two weeks to fit it into belting. You will therefore see the length of time required before the belting is ready for the manufacturers. In the manufacture of cotton goods there is a number of grades and sizes of yarn, and qualities of cotton, and it is practically the same with leather. A great many think that because a piece of leather is hard and firm, it is especially adapted to belting. I disagree with them on this point, for you will find that taking leather which is prepared for sole leather for shoes, the fibre is weakened by the tanning substance, so that the piece of leather with all proper conditions, and not too firm, will stand a larger tensile strain than a solid hard piece. Of course there is no need of my discussing this point, as all are familiar with the virtue of a very firm piece of leather, and what is considered as a soft piece. As a rule you will find that belting leather is not tanned as it would be for sole leather. Usually sole leather is tanned by sulphuric acid or vitriol, while belting butts are tanned by a non-acid process, and no artificial acids.

By leaving pure tanning liquor exposed to the air at a temperature of 60 degrees, it will most likely change from tannic to gallic in about 17 days. I have seen much leather brought out and put on the market, which, owing to the lack of care in preparing and tanning was not worth more than one-half of what it should be. Thus, you see, the great importance of care in preparation.

The leather being thus prepared and ready for belt manufacturers' use, the next essential point is the care in selecting stock that shall be uniform in thickness for the different rolls or belts into which it is to be made. It is impossible to have all hides the same thickness, but it is essential that all pieces entering into a belt shall be as near uniform thickness as possible. Also care should be taken that the firmness of the leather should be much alike in the pieces, as while hides vary in thickness, they also vary in quality and firmness. There are a number of belt manufacturers now in this country who are aiming to make the very best goods. Every one can make a good belt, if they desire to, as it depends largely on the quality of the stock and the care in making up.

In buying belting about the first thing the manufacturer does is to get out his specifications, and then receive bids from various manufacturers of belts. In many cases this is all right, while in other cases it does not work well, for often the man who is cutting low priced leather can make a low price on belting, and in this way he is quite apt to secure the order, and as you can see, of course the man gets what he is paying for. Very often the belt may come up to the letter of specifications, but when it is put to practical use it will be found to be a much dearer belt than a higher priced one. Personally I am a great believer in using good goods, and in the majority of cases, it is found to be far better to do so. Very often specifications for belting are made up to a certain length, say four feet, six inches cut from centers, and then expect a belt manufacturer can sell two-inch belting made from centers, which would be an impossibility, unless he receives a special price for it, and even then it

is better to make such narrow belting from pieces a little each side of the center, for you will find that a center belt as a rule is a little lighter than just one side from the center, or what is termed a "kidney" cut. The majority of belts, 12 inches or over, single or double, are made from centers, and there are very few concerns that make 8-inch or under, especially in singles, from centers unless so specified. Very often traveling men state that their belts are all made from centers, but if they would say they were made from the center part of the hide it would seem more reasonable. In making a belt from what we call the center, there is little or no danger of its running crooked, and even at this point if it is not cut very far down from the center there is no trouble in this direction. Very often a short lap belt made from pieces down on the side, what we call belly strips, looks as heavy as the very best quality, but when put to use it will be found that it does not last, and will not give the service of a better and higher cost stock.

Very often you wonder what makes a belt stretch, and think that a belt which does not stretch is a good one. In this I beg to differ, for one thing is true, and that is, that a belt should stretch some. A belt properly stretched on stretchers at a factory in manufacturing is intended to have the stretch taken very thoroughly out, but if the belt is made from certain parts of the hide, which, in the nature of its location is softer, it will from time to time, in fact from the time the pieces of leather enter into the belt, until it has run a long time, continue to stretch. Belt manufacturers try to overcome this as much as possible, and give it all the stretching they consider sufficient. Again, much depends on the amount of power the belt is required to transmit. Very often an over estimate is made of what a belt will transmit, for I recall places where a three ply belt should be used, where a double belt was put on, and of course the double belt was not able to do the work. Where there is a very heavy strain, whether high or slow speed, I advise a double belt, and if a man buys the best goods a double belt should be made from exactly as good stock as a single belt.

Belts made from butts other than leather thoroughly stretched, tanned and curried will not transmit as much power as a belt should, owing to its being hard and firm fibre, and not fitting the pulley as it should. There is nothing, I think, quite equal to a good oak bark tanned belt. I consider a good hemlock tanned belt preferable to a belt tanned with extracts, as extracts do not have as mild an effect on the fibres of the leather as a pure bark tannage. There are some tanneries that have a larger and better reputation than others, and undoubtedly the same is true in cotton manufacturing. You will therefore see that there is liable to be a variation in price of leather, for reasons which the writer has named, and if so, there are causes which bring it about, but experience shows us that the most conservative and best managed concerns in the country as a rule buy the best goods. Why? Because they consider it more economical.

Belt manufacturers are constantly looking for improvement in the way of manufacturing, and the latest improved machinery. There are concerns, who at the present time, are giving their belts, ordered for main drives, a special running test, at the factory before going out. To illustrate: If a belt 20 inches is required, the stock is cut about 20⅜ inches wide, and the belt is made up this width. After it has been completed, it is placed on pulleys, and given a runing test, for a longer or shorter time as circumstances will allow, to see if the belt is absolutely straight. Afterwards gauges are placed at each edge of the belt and trued up to the width required by the order, thus giving a stretched belt, full width and true running. This is considered a very essential point, and is much appreciated by users, and it should be taken into consideration when orders are placed.

Belts should be run grain side to the pulley, as the grain will absorb more or less moisture and dirt which accumulates on the pulleys, while the flesh side would coat over, and thus detract from the strength of the fibres.

A belt properly made, in most cases will run with the usual cement, without other special fastenings. Of course there are conditions under which it is desirable to have a belt with the

laps riveted or otherwise fastened, but, as a rule, whatever is done to detract from the strength of the belt, by the admission of fasteners, goes so far towards weakening it. If good cement is used, and the belt is properly put together, as a rule it will do the work all right, unless it might be a shifting belt, or as we have said before, unless there are some special conditions where the edges need to be protected. In such cases, of course, we advise fastenings of some description. We think a belt with riveted laps is one of the things of the past.

The PRESIDENT. The next subject in order is Lighting Buildings by Refracted Daylight through Luxfer Prisms, by Mr. GEORGE K. MALTBY of Boston, Mass.

LIGHTING BUILDINGS BY REFRACTED DAYLIGHT THROUGH LUXFER PRISMS.

GEORGE K. MALTBY, Boston, Mass.

The velocity of light as it travels from the sun to the earth is about 186,000 miles a second. When light passes from air to glass its velocity is reduced and it also undergoes a change in direction. This change in direction is called refraction. It is this property of light that has been utilized in the Luxfer Prism method of lighting buildings. No doubt scientists have known of the refracting quality contained in glass for centuries, but the knowledge was never turned to commercial account until within the last very few years. The inventor of the Luxfer Prism was the first to demonstrate that daylight could be transferred or refracted through prismatic glass in sufficient quantities to be of commercial value.

After years of unsuccessful effort by the inventor to interest capital, he finally landed in Chicago, where few things of value remain unappreciated, and this case proved no exception. Luxfer Prisms at that time were very crude and not fully understood by their inventor, who could not explain why the prisms were successful in some instances and not in others. Scientists were immediately employed to solve the problem, and they discovered that each interior to be properly lighted must be studied separately, and an angle of prism used which would meet the requirements in that particular case; therefore where one angle of prism and one method of installation were then used, ninety different angles and methods of installation are now necessary to select from. The services of lucical engineers are also necessary

to determine what particular prism will give the best results in each proposition.

Briefly described Luxfer Prisms are sections of crystal glass having a standard dimension of four inches square. The outer surface is smooth, the inner surface divided into a series of accurately formed prisms. These four inch sections are united and formed into plates of the required dimensions by the Luxfer Prism electro-glazing process, which in itself is an invention almost if not equal to the prism in value. This glazing is exceedingly strong and offers a minimum obstruction to the light passing through the prisms. By this glazing process, the edges of the four inch sections are welded together by a slight ribbon of copper through the medium of electricity. These plates if subjected to a hard blow at any point, instead of shattering the entire plate, the breakage is confined to one, or a very few, prism lenses which can be easily replaced.

Fire underwriters now recognize electro glazed prisms or glass as a fire retardant of considerable value.

With ordinary windows, the most of the direct daylight entering the mill room is lost on account of its striking the dark floor and machinery near the windows. Luxfer Prism sash receive the light that would ordinarily fall near the windows and direct it to the middle or back of the room where most needed. In most cases, prisms are installed in the upper sash. Occasionally where the sky area visible from the windows to be equipped is very small, a canopy or awning is hung over the windows. This receives the light from the sky directly above, and projects it through the window into the room. This method is very effective.

The prisms do not, as it is often supposed, throw light in narrow bands or waves, but quite to the contrary diffuse it from ceiling to floor and to right and left of windows.

Luxfer Prisms do not give the prismatic colors. Goods can be matched in the center of the room by the light diffused. Direct sunlight is not necessary; excellent light is secured upon ordinary cloudy days. This last assertion may upon first thought appear

improbable, and to those who may insist upon doubting the statement, the invitation to step out under the sky and gaze upward upon the first cloudy day, is respectfully extended. The sky on an ordinary cloudy day is more luminous than it is upon a day when the sun is shining brightly. The sun itself is not included in this comparison. The sky is chiefly depended upon to provide the illumination upon the prisms.

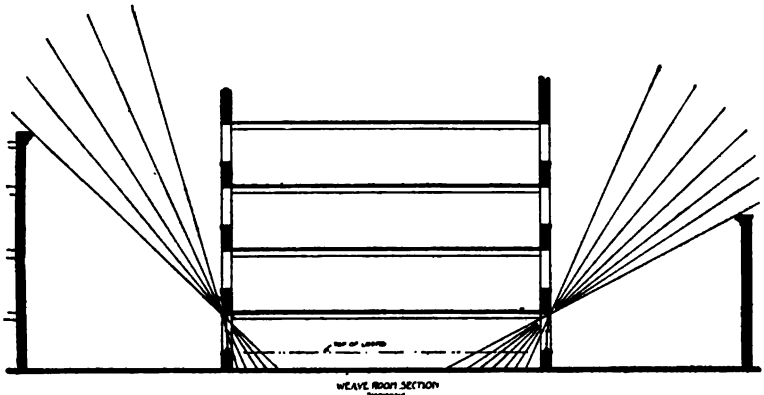
One of the most important, if not the most important feature of the Luxfer Prism lighting system, is its beneficial effect upon the operatives. They are very outspoken in their appreciation.

Mr. SULLIVAN, superintendent of the Troy Cotton & Woolen Mills in Fall River, stated that for years it had been extremely difficult to keep operatives contented in a certain basement room, but since installing prisms there, they now turn on the artificial light on the second floor before they do in the basement mentioned. The benefits are obvious. The operative is given purer air and relief to the eyes. An ordinary gas jet consumes oxygen equal in amount to that used by four men. The introduction of daylight not only makes this waste of oxygen unnecessary, but at the same time purifies the air, and by improving the light and sanitary conditions, a better quality and more rapid manufacture of goods must follow.

A case illustrating to a very marked degree both these features can be seen in the Tremont & Suffolk Mills, Lowell. By request Mr. THOMAS, agent, has furnished the following memorandum, which shows cost of gas consumed in their No. 1 mill, basement weave room, during the following months:

Month of March, 1898,	$63.30
" " 1899,	62.90
" " 1900,	39.50

The prisms were not installed in this room until about the middle of March, 1900; therefore $22.80, the difference in figures, represents the saving during the last half of the month only. Mr. THOMAS also reports that since installing prisms, their seconds in this room have been reduced very materially.


WEAVE ROOM SECTION
DISTRIBUTION OF LIGHT THROUGH ORDINARY SASH.

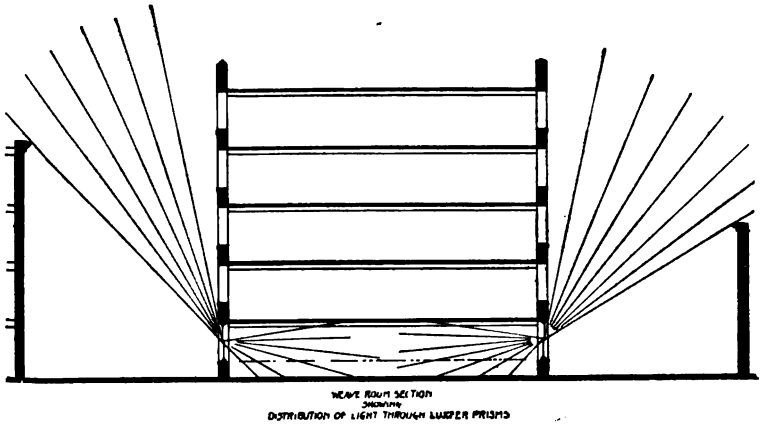

WEAVE ROOM SECTION
DISTRIBUTION OF LIGHT THROUGH LUXFER PRISMS

FIGURE I.

FIGURE 2. ORDINARY WINDOWS.

North half of Tremont & Suffolk No. 5 Mill, Basement Weave Room.

Photograph plate exposed five minutes, 2.45 P. M., April 11.

FIGURE 3. LUXFER PRISM WINDOWS.

South half of same room.

Photograph plate exposed three minutes, 3 P. M., April 11

FIGURE 4. LIGHTED BY LUXFER PRISM WINDOWS.

First Floor Draper Co.'s Setting-up Shop.

Center light well closed. Photograph plate exposed five minutes, 2.30 P. M., April 12.

FIGURE 5. LIGHTED BY ORDINARY WINDOWS.

Second Floor Draper Co.'s Setting-up Shop.

Center light well open. Photograph plate exposed five minutes, 2.45 P. M., April 12.

An exceptionally interesting case recently presented itself in the Draper Co.'s setting-up shop, Hopedale. This building, about 600 x 125, contains three floors above the basement, and through these three floors five light wells, 20 x 40, have been built. The proposition here was to give as good light with the light wells closed, as with them open. The space occupied by a skylight on the first floor was selected to operate upon. After installing the prisms, the light from the light well was shut out. The general light in this space is better than before. This company has since given their order for 308 additional windows. After these windows are installed, the light wells will be floored over, thereby gaining 12,000 square feet of floor space, enabling them to improve the arrangement of the shop, which is not made awkward on account of the light wells, occupying a space that should be used for a runway, and rid themselves of a very dangerous fire hazard.

A prominent mill architect and engineer recently informed us that it was his constant aim to keep down the ceiling heights to the lowest possible point. The low studded room is the most economical, and is the best for weaving purposes. This being the case, Luxfer Prisms have another field open to them. After inspecting some of the Luxfer Prism mill work, the most sceptical must be convinced that the following proposition is feasible. Take as an example a building with a first floor room 300 x 100 and 17 feet high. As good general light can be secured throughout this room with five feet taken off the ceiling height, if Luxfer Prisms were used. If this statement is correct, what will be the gain by this form of structure? First, you will save five feet in height in the construction all around. There will be 150,000 less cubic feet to heat and keep moist. A proportionate amount can be taken off the height of all the rooms above. This saving in height on all the floors can be put into one or two additional floors, a proposition well worth investigating.

If prisms are successful in the regulation mill building, they must also have their place in the saw-tooth structure. One-

half of the skylights in the roof of the saw-tooth style of weave sheds can be omitted by using prisms, thus making a saving in the cost of heating and maintenance. Where the ordinary skylight glass is hung at an angle, prisms may be hung in vertical sash, thereby reducing the liability of leakage and dropping from condensation. The prism skylights being twice the distance apart, the roof is not as liable to form drifts of snow or get out of repair.

The prisms are easily cleaned by using a stiff fibre brush on the prism side of the plate. The ordinary method of cleaning can be used on the outside. To get the best results, the prisms should be cleaned three or four times a year, in some cases oftener, or as occasion may require. In cases where it is desired to cut off the view from the outside, prisms can be used to advantage in the lower sash.

When the light throughout a room is only slightly defective, prisms in every other window, on one side of the room, would be sufficient. The saving of artificial light and the improvement in the general light in such a proposition upon cloudy days, the changing from the slightly defective to good light on other days, will soon return the original cost of prisms. With reasonable care, the prisms should be as durable as any part of the building.

Another important feature in this connection was brought to our attention by MR. SOUTHWORTH of the Massachusetts Mills. He states that the daylight hours in their weave rooms have been prolonged since installing prisms. This feature can be best appreciated during the short winter days.

This statement is frequently made, "Unless we can see a good investment in the actual saving in the cost of light, it will be but a waste of time to discuss the prismatic method of illumination." How often is it the case that operatives are compelled to grope about in the middle or dark portion of a room which is poorly lighted because you do not want to start the dynamo or light the gas? A thread is broken, the machine is stopped. Take the difference between the time it takes to repair that break or flaw under good light and that which it takes to repair

the same under defective light. Multiply the difference in time by the average number of breaks per day on each machine, and then estimate the total net loss of time during one year on all your machines poorly lighted. The result will give an approximate idea what your loss is from this feature alone. Can you secure best results from an operative possessing good health and a strong body? Is not such an operative capable of doing more and better work than one who does not possess these qualities, and is not such an operative a better investment for you, even if he is employed on the piece scale? Is an operative more likely to possess or acquire a healthy eye and skilful hand, in a room artificially lighted or dimly lighted, or in a room lighted by natural light with the sunshine streaming throughout it? You may reply that the operative is employed by the cut, and it makes no difference to you as an investment. Every second that the running of one of your machines is delayed for want of proper facilities, you waste time and power, consequently you are not making the most of your investment. After all has been said and considered regarding the investment side of the proposition, should not the operative from the standpoint of humanity have some room in your thought, while you are considering the question? Their conditions and surroundings are none too happy even at the best. Is it not your duty to give them two of the great essentials of life, sunshine and pure air when it is so easily within your reach?

The advantages of the Luxfer Prism windows in mill propositions may be summed up as follows:

1st. Better quality and more rapid manufacture of product.

2nd. Improvement of the sanitary conditions and beneficial effect upon operatives.

3rd. Saving in cost of artificial light and reduction of the fire hazard.

The light in old style buildings can be placed on a par with modern mills.

New mill buildings can be built containing less height in ceiling, thereby providing a better room for weaving purposes and securing a saving in cost of building and running gear.

Mr. EDWARD ATKINSON. I did not get in in time to hear the paper on the Luxfer prism. I wanted to ask the gentleman who read it a question as to the relative cost in respect to the full glazing of a mill.

You are aware that I have given a good deal of attention to the matter of lighting—

Mr. GEORGE K. MALTBY. Yes.

Mr. EDWARD ATKINSON. Giving regard to the question of economy, and appreciating fully the value of the prismatic form under certain conditions, the question arises on the difference between deflection of light and diffusion of light,—an important matter. The question that I put is taking a whole mill—what is the relative cost of glazing wholly on the Luxfer prism system as compared to the ordinary cost of glazing with clear glass or ribbed glass.

Mr. GEORGE K. MALTBY. The relative cost is possibly 10 to 1, if you consider the glass only; possibly more. That is something I have never figured out, therefore cannot answer you accurately.

Mr. EDWARD ATKINSON. That, of course, is a matter of importance to be considered. The next question is as to the relative merits of the diffusion of light, by the use of the ordinary ribbed glass and the deflection of light by the use of prismatic glass.

Mr. GEORGE K. MALTBY. Well, possibly that can be best answered by stating that we have removed factory ribbed glass in a few places and replaced it by Luxfer prisms. The difference in the diffusion of light, I can safely say, throughout a mill room is about 10 to 1, in favor of Luxfer Prisms.

Mr. EDWARD ATKINSON. Can you tell me exactly where you have removed—

Mr. GEORGE K. MALTBY. Yes, the Pepperell Mills. The following is the experience we had in the Pepperell Mills: we took their main weave room in the Pepperell division and equipped one half of it. In this one half were 17 sash of factory ribbed glass which we removed. Apparently the results were satisfactory, for we received an order to take out the balance of the ribbed glass with other windows in this room, and equip them with Luxfer prisms. The Luxfer prism, ribbed glass question was again encountered at the Merrimack Mills. I told Mr. PEAD, the Agent of these mills, that the best way to settle the question would be to put in five or any number of sash which he desired of Luxfer prisms and next to them put in the same number of sash containing factory ribbed glass. He ordered the sash at our expense, provided we failed to sustain our claims of superiority over ribbed glass, all of which we agreed to, His idea to alternate sash, putting in one ribbed glass sash and one Luxfer prism sash, was adopted. Ten rubber curtains were then provided, one for each window experimented upon. The intention being to entirely cover the prism windows and at the same moment remove the curtains from in front of ribbed glass windows, then reverse the operation, that of course showed the comparison. We have received orders to equip other rooms in these mills since making the experiment, and the ribbed glass, I understand, has been removed.

Mr. EDWARD ATKINSON. Are those basement rooms or ordinary rooms?

Mr. GEORGE K. MALTBY. Basement rooms.

Mr. EDWARD ATKINSON. That is the point I want to bring out. I would remark that there are certain places in manufactories like basement rooms where you have insufficient light anyway, where the deflection through the Luxfer prism and sending the rays of light in the particular direction, especially up against a white ceiling, in order to get diffusion by reflection, is unquestionably a better method of getting light and quite

worth the extra cost than the ordinary method of glazing with ribbed glass. My point is not to show any demerit; I fully realize, and in the publication that I am just about making—

Mr. GEORGE K. MALTBY. While you are at that point, Mr. ATKINSON, I will go further and say that in any place where you need an increase in light, in any place at any point in the mill, Luxfer prisms will be as effective and show as great improvement in that portion of the mill as they will in the basement or in any other part of the mill where wide diffusion of light is required. If wide diffusion of light can be secured in the basement, it can also be secured on the floor above, and on the floor above that; you cannot limit it. That statement has been made before, and if for your satisfaction or for anyone's satisfaction, you desire to have that tested, we stand ready at any time to demonstrate; in your office, if you desire.

Mr. EDWARD ATKINSON. It is not a question of my satisfaction at all; it is a question of how our friends here will get an effective diffused light equal to their requirements throughout large rooms—not in specific places or in separate basements—at the least cost.

Mr. GEORGE K. MALTBY. In that case, which is an instance like one touched upon in my paper, we will equip one or two windows and put in prisms, and we will agree at the same cost to give you a wider diffusion of light, more light in that room, than can be secured by ribbed glass.

Mr. EDWARD ATKINSON. I would like to see that tried very much.

Mr. GEORGE K. MALTBY. I will do it with pleasure.

Mr. EDWARD ATKINSON. Because the photometer does not quite agree with that statement.

Mr. GEORGE K. MALTBY. Mr. ATKINSON, if you will allow

me to discuss this matter a minute; do you refer to the test made by Professor NORTON?

Mr. EDWARD ATKINSON. Tests made all the way for the last 16 years. You are familiar with my circular on ribbed glass in which I first called attention to it.

Mr. GEORGE K. MALTBY. I imagined that must be it, and I asked Professor NORTON to describe his test. He said that he took a wood box, put it out of a window; at the end of that wood box or funnel or whatever you may call it—

Mr. EDWARD ATKINSON. All that, our friends are familiar with; that has been printed.

Mr. GEORGE K. MALTBY. Yes. He put at the base of that box a prism; he also put at another time a piece of ribbed glass. I asked Professor NORTON at the time whether he understood that the direction of light from a prism depended upon the source of light. He appeared to have no idea that there were various prisms. As a matter of fact, we have about 90 different forms of prisms. We could install prisms in a mill room, and if the right prisms for that particular proposition were not prescribed, they would, if anything, take away from the light in this room. I asked him how he got those prisms; he said he sent to New York. I asked him if he told them what he wanted them for. He said no, he secured them through an acquaintance. At the time of our talk he was not aware that Luxfer prisms diffused light. Its light diffusing qualities is about all that is claimed for Luxfer Prisms.

Mr. EDWARD ATKISON. The only caution I would give, and the only point I want to make to our friends here—of course I have no personal interest in the matter one way or the other—

Mr. GEORGE K. MALTBY. No.

Mr. EDWARD ATKINSON. I had heard that the representa-

tives of the Luxfer prism had been very much disturbed over alleged opposition to them which never took place, and never had any existence. The fact is that my attention to the diffusion of light was first called to the glazing of the English mills in 1883 with rough plate glass, giving a very dark look outside. I then asked why they did it; they said to get better light inside. I then went into these large spinning mills 128 feet wide and of a given length, and I found a better light than it was customary to find in such rooms. That set me to reasoning upon the matter. I then reasoned out the theory that there was diffusion in that uneven surface. I then went over the philosophy of the thing, and reasoning on the FRESNEL lens, if by means of lenses or prismatic forms the rays of light could be sent in one direction concentrated, then by other prismatic forms the rays of light could be diffused. I then took up the matter—this was, I think, in 1884—went to the glass makers and found that it would cost $5,000 to get up the plant for making glass prisms computed on the lines of diffusion, and then when that was done the cost would be as you state, about 10 to 1. Had I then proposed to our friends how to spend ten times as much for prismatic glass as plain glass would cost them my report and influence would have suffered an eclipse.

It did not seem to me that that was a practical suggestion to make. I then sent around and got samples of every type of glass that I could find in the market. I had the images photographed. I have them in the office now. Among them were various forms of prismatic glass. And to my surprise, the ribbed glass worked the greatest diffusion of light under ordinary conditions. We then had it tried in one or two places, and we found after some experience that there were very serious objections to the deflection of the rays of light on horizontal planes on account of the effect on the eyes of those whose eyes might be exposed. We therefore changed the direction of the ribs from horizontal, which seemed to be the best way to diffuse, in order to get rid of that exceedingly bright line which the oculists condemned for cause, and then set the ribbed glass

in vertical position. I happen to have been within the last week in a large silk mill, where the old mill had been glazed with plain glass and the new mill is glazed with ribbed glass. The light would leave no question open in anybody's mind about the relative merits of the ordinary ribbed glass against the ordinary plain glass.

But there has been no prejudice or effort to stand in the way of the introduction of prismatic glass. On the contrary, in my latest publication which is about coming out, I state that in certain cases, or in basements, or where it is an object to deflect the rays in given directions, it undoubtedly has very great merit. There may be specific parts — I should imagine that possibly in the engraving rooms in a print works, where it is desirable to throw the rays at given points, you would get more light at the point needed by the prismatic glass than by the ribbed glass. But for the general diffusion of light I am inclined to think the ribbed glass is still so complete in its results that it would turn on the matter of expense even if it were proved that the prismatic glass could be so arranged as to give absolutely as good a diffusion, which I question. Since you have had any conversation with Professor NORTON a great many additional experiments have been made under various conditions. And for general diffusion I should suggest that the ribbed glass still stood in economy and effectiveness worthy of attention without going to the extraordinary expense of glazing a whole mill with prisms.

Mr. GEORGE K. MALTBY. I would like to set you right, Mr. ATKINSON, on one point. It may not be the time to do it, but you said that we appeared to be disturbed. I think you are laboring under a misunderstanding. We have never by word or otherwise said anything derogatory to you or your article. There was an article written —

[Here Mr. EDWARD ATKINSON rose.]

Mr. GEORGE K. MALTBY. Wait a minute, please. There was an article written that I understand was very bitter, but that

did not come from the Luxfer Prism Company, and if you will find the article you will find it signed by some one in another company. Now you speak of experiments made by Professor NORTON. I expect there have been experiments made since I visited Professor NORTON. At the time I made the request of Professor NORTON to allow me to instal prisms in his laboratory, or in any place which he might select at our cost, we to furnish both the prisms and the ribbed glass, he handled Luxfer prisms in the same way that might a man take hold of a piece of mechanism which he did not understand and comparing it to something crude; the crude or inferior machine might in that case prove superior to the fine machine that he did not understand. And I will stand ready to and before you publish your article I wish you would give me an opportunity to demonstrate; I know I can convince you as I have wanted to before, that the Luxfer prisms are so far superior to ribbed glass in every case that you will acknowledge it publicly. I want that opportunity We have now 130 installations of prisms in mills throughout New England, in all kinds of places; in the upper floors very often; take for example the Massachusetts Mills, we have them in the fifth floor; and we have them at angles running from 80 degrees down to 40, 30, 15, in every angle that you may want we will try it; I can take you around and show you cases in town. You are the man of all men in New England whose good opinion we desire, and I want you to meet us half way.

Mr. EDWARD ATKINSON. This is the first time I have met Mr. MALTBY or ever had any suggestion of the kind put before me. At a suitable time and place these tests may be made and the right place where the excessive cost of prismatic glass may not forbid its use may be defined.

Mr. GEORGE K. MALTBY. I worked through Professor NORTON.

Mr. EDWARD ATKINSON. The attack on Professor NORTON

as I was informed, came from a representative of the Luxfer Prism glass. I am glad to know that this was an error.

Mr. GEORGE K. MALTBY. I beg your pardon, Mr. ATKINSON —

Mr. EDWARD ATKINSON. They came from one of the prismatic forms of glass which I suppose to be the Luxfer — directly to the managers of the Institute of Technology, objecting to the unscientific character of Mr. NORTON'S experiments and objecting to the attack said to have been made on their patents. That is all I have ever heard —

Mr. GEORGE K. MALTBY. Mr. ATKINSON, that —

Mr. EDWARD ATKINSON. Allow me to finish. Since then I have been to see the Luxfer Prism installed in many places and have been quite ready at any time, if any application had been made to me, to test the Luxfer Prism in any way that would be suitable for me to expend money on the part of the manufacturers in their interest. No such application has ever before been made directly to me by any one, but these attacks did emanate from some one. On the other hand, I have recommended the Luxfer Prism in several or many different cases of difficult places into which to project light. I only want to bring out the fact that so far as we are concerned, so far as we may be justified in spending money belonging to the Insurance Fund on behalf of the manufacturers, it would be quite suitable if any gentleman here, any manufacturer, will make the customary request. You are all aware that we never undertake anything at the instance of an inventor directly. Our trust has been betrayed and has been lately betrayed by the misuse of some of our publications in fraud upon other people on another matter in which Professor Norton investigated; that is on the matter of pipe coverings. Our reports have been misused in fraud. Now Professor NORTON is not the kind of man to stop, as you very well know, till he has got to the bottom of a

thing. He does not work at your instance, probably, because this investigation has been under my control and general direction, and when any gentleman here desires to have a comparative test of Luxfer Prism as against ribbed glass dealt with completely, so that the measure of benefit may be set off against the measure of cost, we are always prepared to do it. This is the first time that any application has been made to me on behalf of the Luxfer Prism to test it against ribbed glass for the benefit of the Cotton Manufacturers.

Mr. GEORGE K. MALTBY. I will go this far: if any mill corporation would like such a test, it will cost that corporation nothing to make it. We have done that before. And Mr. ATKINSON, as to that letter to the Institute of Technology, the Luxfer Prism Company did not write it.

Mr. EDWARD ATKINSON. Are there not two or three companies?

Mr. GEORGE K. MALTBY. Yes.

Mr. EDWARD ATKINSON. Well, I have looked over all the patents and I thought they were all one.

Mr. GEORGE K. MALTBY. No, sir. The company which was represented by the author of that letter has since practically dropped out of existence.

Mr. EDWARD ATKINSON. I am very glad to know it

Mr. GEORGE K. MALTBY. Yes, sir.

Mr. EDWARD ATKINSON. Because it was very discreditable to the whole system of prismatic lighting.

Mr. GEORGE K. MALTBY. Yes, sir.

Mr. EDWARD ATKINSON. We only want to get at the truth, of course. We never permit ourselves to take any patent.

I have lost several fortunes by not being permitted to take a patent on several inventions. [Laughter.] I have just published a new fire door, on which there will be no patent, and I saved you all on your sprinklers from a blackmail royalty several years ago, where every original Walworth sprinkler and every original Grinnell sprinkler with a lever in it would have been subject to the claim for royalty if I had not happened to invent the same method of using a lever a year before and published it in our reports. The claimants had actually obtained a decision in their favor in the District Court of the United States in Chicago and were coming east to put a claim on every one of you, who had about 2,000,000 sprinklers in at that time, for 25 cents apiece. My happening to have invented that use of a lever in connection with an automatic door, and the conversion of a pipe system into an automatic system, knocked that case right out of court. That is one of the little incidental benefits you got which I never received much credit for.

Now in this matter, when I began looking into it, I sent for every patent that there was on the use of prismatic glass for the diffusion of light. You will bear in mind that my original idea of diffusing light was by the use of prismatic forms. I looked up the whole subject and found the high cost an insurmountable objection to any general use in the glazing of a mill. Mr. NORTON is fully aware of the varying effect of different angles, many of which we have tested in various ways. There are some very valuable patents for the method of framing, some of which are admirable, but no patent can stand a moment on the diffusion of light by the use of prismatic glass. I am very glad to meet Mr. MALTBY; I wish he had come to see me before. I have heard that he had complained or had objected to some of our methods. We have gone a good deal beyond those methods since. One of the most lovely things that I should like to show you — I have not published it — is a picture of a baby looking at you with a bright light coming through plate glass — not direct rays of sun on the baby's eyes, but bright light. The baby's eyes are contracted by the glare of light.

Then the ribbed glass is swung into position, the baby is looking up smiling and testifying to the difference in the quality of the light between the plain and the ribbed. There is precisely that difference between the effect of some of the prisms and the ribbed glass on the eyes of those who are doing the work. You must be careful. I only give you a caution. I have no interest except that we get the best glass at the lowest price for practical and general use.

ADDENDUM BY MR. ATKINSON, JUNE, 1900. Since the foregoing discussion, several members have requested me to make tests of various types of glass. After some alterations in our offices we shall have two very large and wide rooms clear,—on the east side eight windows. We shall ask the representatives of glass to take two windows each and glaze them. We will put up separating screens. We hope Mr. MALTBY will fit two windows, the Solar Prism Co. two. We shall fit two with ribbed glass and two will be fitted with a new glass rolled in prismatic angles but in underlating lines, claimed to combine the merits of both rib and prism. This type will be made on large sheets, set in ordinary sash at a very moderate cost.

Mr. GEORGE K. MALTBY. I would like to hear from some of the other gentlemen. As I said before, we have 130 mill installations in New England, and there are several here who could answer as to the relative value of ribbed glass and Luxfer Prisms.

The PRESIDENT. The next paper is upon the Warming and Ventilation of Mills by Prof. S. HOMER WOODBRIDGE, Boston, Mass.

WARMING AND VENTILATION OF MILLS.

S. HOMER WOODBRIDGE, Boston, Mass.

Two types of mills are of prime importance to the mill-man; one the plant, the other the profit. His study has heretofore been, is now, and will continue to be chiefly concentrated upon the problem of reducing the cost of the plant and of its operation, consistently with increasing the output and the profit. Any mill-man in a position to insure for himself a per yard cost of production by so much as a single mill less than his competitors is in a position to command a lucrative business.

It is the one-tenth-of-a-cent mill with which this paper is concerned; with the prevention of waste which reduces and often wipes out profit. It relates to the storage of profit through the stoppage of waste in the operation of a mill plant, in respect to fuel consumption, and to the efficiency of employees.

Waste results whenever the maximum practicable return for any given outlay is not realized. It begins in heat and power production where, with boilers, furnaces, chimneys and fuel capable of obtaining from 10½ to 11 pounds of steam per pound of coal, the average yield is but 8½ to 9 pounds. Such waste is preventable; first, by insistence on the employment of firemen well trained by schooling and by practice, not merely to the shoveling of coal and the hoeing of ashes, but to firing with reference to a minimum fuel consumption and maximum steam production. A saving of waste in this one item may range from

10 to 15 per cent. of the fuel account, or from 40 to 60 cents per ton of coal burned. In the case of a mill using 10 tons of coal per day, the loss through wasteful firing may be from four to six dollars per day, most of which might be saved by such a thoroughly trained and faithful "steward of the black diamonds" as might be had for an advanced compensation of from 50 cents to $1.00 per day. It is a conviction born of personal experience, that the establishment and maintenance of a school for the training of men in the proper and effective use of fuel would prove a profitable investment for any association of mill-men or manufacturers.

Another common source of loss is in the potential and actual heat which escapes through chimneys in smoke and in hot gases. The heat loss in the un-oxidized hydro-carbon issuing in smoke is, perhaps, unfortunately so small — amounting to less than one-half of one per cent. of the thermal value of the fuel — that its prevention cannot be strenuously urged on economic grounds, and yet, if one-half of one per cent. of the yearly fuel bill may be saved by the burning of smoke, a gain of $75 for each 3,000 tons of coal burned could be realized, or, beside reducing or perhaps even removing a serious public nuisance, enough to cover the cost of interest and repairs on the best of smoke consuming furnaces.

The heat escaping with the combustion gases may and often does reach 20 per cent. of the total available from the fuel. This heat is available for a few purposes, such as the heating of feed water for the boilers, or of air for the buildings. It is of relatively low value for super-heating steam, or for heating water for mill warming. This is due to the fact that the initial temperatures of the steam or the water are so high that the surfaces required for the absorption of heat become excessive, and the cost of the installation and operation and maintenance of the necessary economizers becomes so high as to almost neutralize all gain in heat utilized.

By using the heat of chimney gases for heating feed water or

air, it is possible to release an equivalent steam quantity for other duty, and by so much to reduce fuel consumption. If one-half of the usually wasted heat of chimney gases can be utilized, the coal combustion can be in many cases reduced by ten per cent. To effect the transfer of that heat from chimney gases to cold air there would be required approximately five square feet of metal surface for each boiler horse power. The arrangement required would be essentially a self cleaning economizer, the walls of the pipes being thinner, and the general construction much lighter than for feed water heating under boiler pressure. The costs off-setting the gain made by such methods would be chargeable; first, to the expense of installing, maintaining and operating the economizers; and, secondly, to the expense of increasing height and size of the chimney, or else of installing and operating mechanism for forced draught. Computation, which cannot at this time be entered into, makes it evident that when the heat transfer can be made from hot chimney gases to water or air having a low mean temperature, the process is well within the region of profitable economy.

Leaving now the boiler room, and passing to the engine room, the range of possible waste and saving is increased. The engine can at best convert but a small fraction of the steam's heat into power. The balance of the heat should be utilized if costly waste is to be avoided. The type of engine should therefore be chosen with chief reference to heat required by the mill and the mill work outside of that converted into power by the engine. If the mill requirements call for more steam or heat than the exhaust from the engine can furnish, the simplest type of slide valve engine is as economical as any. If, on the other hand, the demand for other steam or heat is small, the type of engine using the least per horse power steam quantity is essential to economy, and in the compound condensing engine is then found the acme of mechanical economy and of thermal effectiveness. Theoretically, the heat expended in work is 2,545 British thermal units per hour per horse power, and that escaping with exhaust

steam from an engine using 30 pounds of steam per horse power per hour is approximately 26,000 thermal units. The latter quantity is materially, although variably reduced by chill and condensation within the cylinder. It is, however, so much in excess of the quantity converted into power that its waste is at great cost when its heat is usable.

The use of a compound condensing engine when the exhaust from a simple engine doing the same work could be fully utilized is in the line of waste. If the non-condensing engine uses 27 pounds of steam per hour per horse power, and the compound condensing engine 15 pounds for the same work, then the mechanical advantage of the compound condensing over the non-condensing engine is 12 pounds of steam per hour per horse power. If, however, the compound condensing engine is used when a quantity of steam equivalent to the exhaust from an engine using 27 pounds of steam per horse power per hour must be furnished from the boiler in the form of "live steam" the thermal and total economical advantage is on the side of the simpler engine. The exhaust steam from such an engine is roughly 30 per cent. condensed, or mist, and 70 per cent. vapor. For heating purposes 27 pounds of exhaust becomes therefore equivalent to approximately 19 pounds of live steam. When the condensing engine is used in cases where the total exhaust of a simple engine could be utilized, the total live steam equivalent would then become 15 pounds for engine work and 19 pounds for heating work, or a total of 34 pounds, against a total of 27 pounds for the simple non-condensing engine. It is evident, therefore, that under ordinary conditions of mill work which require considerable quantities of steam in excess of that required under the best conditions for power, the highest economy is reached when non-condensing engines are used and the exhaust of such engines is applied to some form of heating work.

The use of exhaust steam is erroneously supposed to necessarily involve objectionable back pressure in engines furnishing such steam. Back pressure in a working engine is a condition

to be avoided in the interests of economy. Where conditions make its avoidance impracticable it may be best, because at smallest cost, compensated by increased boiler pressure rather than by increased steam volume at unchanged pressure. Thus, if the mean effective pressure upon an engine piston is 40 pounds when exhausting against atmospheric pressure, a back pressure of 10 pounds will increase the engine's work by 25 per cent. If under these conditions the boiler pressure remains constant the cut off must be increased to bring the mean effective pressure up to 50 pounds. If the original cut off was one-third, the changed cut off will be approximately one-half. Such a method of meeting the effect of back pressure must result in an increase of approximately 50 per cent. in the steam consumption. If, on the other hand, steam pressure be so increased that the same steam quantity shall do the work by raising the mean effective pressure from 40 to 50 pounds, or the boiler indicated pressure by some 25 per cent. say, from 80 to 100 pounds, the increase in imparted heat to the boiler water and steam is less than five thermal units per pound of steam used, as against nearly 1,000 thermal units required for each pound of water at 200 degrees converted into steam at 80 pounds, indicated. The use of higher pressure steam involves, however, a further loss than that above indicated, such as the higher temperature of escaping flue gases, loss of heat through boiler walls, the greater condensation of steam within engine pipes and cylinders, etc. If the aggregate of these losses amounted to four times the heat required to raise the boiler pressure from 80 to 100 pounds the cost of meeting the effect of back pressure by means of increased boiler pressure would yet be much more economical than to off-set the back pressure results by increased steam quantities at a constant pressure. The latter method would, under the conditions assumed require about 50 per cent. more steam. The former method, as we have just seen, would require not more than from two to two and one-half per cent. increase in fuel consumption.

For mill heating purposes it is not, however, necessary to carry a back pressure in the pipe system which shall be sensibly

in excess of atmospheric pressure. The rate of flow of steam through pipes varies as the square root of the unbalanced pressure producing flow. The unbalanced pressure must be due to a higher tension at the engine end of the piping than at its terminal points. A pressure difference of two to five pounds may exist equally well, whether the actual pressure at the engine end be ten pounds or one pound. If the initial pressure is atmospheric, the lower, or what may be termed terminal pressure must be produced by artificial means, such as by a condenser chilled by the flow of cold water through it on the way to some uses of the mill which require warmed or heated water. The condensation and the entrained air carrred with the steam can both be removed from the condenser by means of a pump. To impose upon a pump the duty of removing steam for the purpose of reducing pressure would prove costly in operating the pump and to some extent in the loss of steam through the pump suction and discharge.

Engine back pressure may also be avoided by giving to the distributing mains sizes such that the pressure required to insure the distribution of steam shall be small. The impulses due to the escape of steam by the engine, together with the slight pressure produced from such discharge, may be sufficient to carry steam through long runs of mains and through ramifying branches. When exhaust steam is used for heating water, whether for mill warming or other purposes, it is possible to discharge the steam from the engine almost directly into the water heater, and to make such a heater answer the purpose of a low vacuum condenser. Into a discussion of details concerning the manner by which such work may be most simply, effectively and economically done, it is not practicable to enter in a paper the object of which is to offer suggestions rather than to furnish specifications.

Exhaust steam when condensed still contains heat which cannot be wasted without cumulative loss of serious proportion. The heat going to waste in such water when running away at 212 degrees is the precise equivalent of the heat given to the

same weight of feed water when raised from 60 degrees to 212 degrees. Roughly from one-fifth to one-fourth of the exhaust steam of an engine is required for heating its own feed water, the value of the fraction depending on losses due to cylinder and extraneous condensation. Or, to put it in another way, one-seventh of the total heat of live steam furnished an engine is required for feed water heating when the work of the boilers is solely that of furnishing steam to the engine. That is to say, if the heat from the condensed exhaust could be transferred to the feed water, a saving of one-seventh of the cost of the engine's steam could be made, provided that the heat of chimney gases and of exhaust steam can be effectively utilized in other work. The amount of heat which in 300 days of a working year is lost in exhaust condensation thrown to waste from a 100 horse power engine using 27 pounds of steam per horse power hour is approximately 100 x 27 x (212 — 60) x 9 x 300 = 1,108,-000.000, B. T. U., or an equivalent of 55 tons of coal.

The surest and the simplest method of conserving the heat of exhaust condensation is to run the condensation uncooled direct to the boilers. The chief deterent to that method of its use is the presence in that water of oil. The separation of that oil is easily possible, but almost inevitable negligence in the care of the means used for its separation renders it hazardous to advise the general use of exhaust condensation heat in that manner. It is certainly safer to recommend the use of heat transferers and the waste of oily water, rather than of separators and the use of doubtfully purified condensation. On the other hand the continuous supplying of aerated, saline, or alkaline waters exposes the boilers and the piping to the dangers of corrosion, scaling and incrustation, from which they would be largely protected were the same water used continuously. The importance of such protection to boilers and piping makes some risk attending the use of exhaust steam condensation permissible, and emphasizes the importance of perfecting methods for oil separation into which the personal factor shall not so largely enter as it now does in the means commonly employed.

Having thus hastily passed through the boiler and engine rooms, the problem of heating and ventilating the mill itself is confronted. The opening of the door introduces us to an interesting object lesson in economics, for in the carding room, the spinning and the weaving room is found a reconversion into heat of the power into which the heat of the steam was converted in the engine. The total power expended through shafting, belting, and in the machines and looms eventuates in heat, and that heat plays its part, and often an important part, in the warming of the enclosures. Every per hour horse power of work done within a room yields to it 2,545 British thermal units or enough heat to raise 14,000 cubic feet of air 10 degrees Fahrenheit, or as much heat as would be lost through 200 square feet of brick wall when the outside temperature is 0 degrees and the inside 60 degrees and a moderate wind blowing. The heat developed by the transformation of power into thermal equivalent in a mill using 100 horse power, developed by whatever means, as by water, steam or electric motor, is, therefore, sufficient to compensate for heat loss through 20,000 square feet of wall surface, excluding windows. This illustration suggests the practicability of heating mills by water power, and through the medium of electricity when such power in sufficient quantity is available.

Another feature in mill warming work is in the general absence of interior walls in mill construction. Because of the greater warmth of such walls over outside walls, the heat radiation from them to outside walls increases the heat lost through the latter to such an extent that the per unit area rate of loss from the outside wall of a room having three inside warm walls is approximately 40 per cent. greater than when all the walls are exposed, as is generally the case in mill construction. In the two respects of power heating and reduced wall cooling a mill has, therefore, evident advantages over the ordinary type of buildings in the matter of heat quantity required for their warming.

The problems now encountered and the side issues involved

are too numerous and varied to be discussed in a paper kept rigidly within economic limitations. The several possible methods of mill warming to be now mentioned will therefore be discussed with sole reference to their relative economy and effectiveness.

Undoubtedly overhead direct heating must be accepted as a working necessity in mills. It cannot be approved on the score of economy, especially in rooms in which the air is not vigorously agitated by running pulleys, belts, machinery or other means. The heat wasted by this method of warming as the price of convenience and necessity is in the aggregate large.

The custom, more or less in vogue, of continuously warming mills through twenty-four hours for the eight, ten or twelve working hours per day is, under ordinary conditions, wasteful so far as the question of heat alone is involved. Under conditions otherwise constant the rate of heat loss varies with the difference in temperature between inside and outside air and surfaces. The warmer a mill is kept, and the longer it is so kept, the greater the heat loss. On the other hand, the cooler a mill is at night, and when shut down, the less the loss. Economy therefore favors as near an approach as is practicable to warming a mill only when the mill is occupied, or in other words, to an immediate warming when opened, and an immediate cooling when shut down. In other words, the longer the process of warming, the greater the quantity of heat travel through the walls. Quick warming, on the other hand, requires a correspondingly large production and condensation of steam in a brief time, and in cases where such production and condensation involve a large increase in boiler capacity and in the radiating surfaces, the economic problem becomes a question on the one hand of gain in heat cost, and on the other hand of loss in interest on the requisite extension of the plant, or through other incidental causes. The question of economy is one which must be determined individually for each case in accordance with the several factors entering into the problem which that case presents.

The system of heating piping within a mill is for two purposes:—first, the mains and branches for distributing heat from a central point or from central points of production to the many and widely separated points of its application; and, second, for the transfer of that heat from the vehicle conveying it to the air and material to be warmed by it. In a mechanical sense it may be immaterial what that vehicle is, whether steam, or water, or brine, or air. Because of the exceptionally high specific heat of water, as well as its relatively high specific gravity, it possesses special value as a medium for the storage, as well as for the carriage, of heat. Also, because its rate of flow through heaters, either radiators or circulation coils, can be closely regulated by a single valve, a water system furnishes better means than a steam system for temperature regulation. A system having 10,000 square feet of radiating surface will contain from seven to eight tons of water, and a change of 30 degrees in the temperature of that water involves the transfer of nearly 500,000 thermal units, or an hour's loss of heat through 36,000 square feet of 18 inch brick wall in zero weather. Water is thus to a heating system what a large fly wheel is to an engine. It stores up the surplus when a surplus exists, and it carries over and yields that surplus when the supply at the source drops or fails. By adding a storage tank of 250 cubic feet capacity for each 10,000 square feet of heat surface used, the storage value of the water in the system may be doubled.

The cost of installing a hot water system must exceed that of an equivalent steam system, for the reason that radiating surfaces must be larger and because power must be used for mechanically circulating water. The power necessitates engines and pumps and some small outlay for steam; the steam, however, not being lost, as it may be turned to account in heating the water it circulates. The engine and pump work also ultimately resolves itself into heat, so that nothing is lost. The mechanical circulation of water makes a rapid flow and use of small pipes practicable in mains and branches. It eliminates the necessity of providing and carefully maintaining such carefully made grades

in pipe runs as are essential to water flow in gravity work. Water may be sent in any and every course under the action of a centrifugal or screw pump. In a paper prepared for the purpose of promoting economy in methods and practice the plunger or piston direct acting pump can be mentioned only to hold it up to condemnation.

The advantages of water over steam for heating work are in a measure offset by the fact that power is essential to the circulation of water, whereas steam, even at low pressure, is automobile. For night or shut down heating work beyond the capacity of the system's storage, a use of water necessitates the use of power, though in small amount, approximating a range of from 500 to 1,500 foot-pounds per cubic foot of water circulated.

In the summing up for water as against steam it may be said: First, that by its use the engine exhaust may be condensed and the water heated without back pressure effects, the heater playing to some extent, at times, the part of a condenser. Second, that when required, as in extreme weather, the water so heated, may be further heated by live steam surfaces, either in the same or in another steam heater or by a furnace heater. Third, that the water within pipes and the storage tank conserves heat by storing it. Fourth, that the temperature of the entire body of water is made perfectly controllable, either by hand or by automatic means. Fifth, that room temperatures are made easily controllable by regulating, by means of a single valve, the waterflow through the heaters within any room or apartment. Sixth, because of its heat storage capacity, water can maintain mill temperatures after shut down as steam cannot. If equal volumes of water and of steam at 212 degrees be cooled to 32 degrees, the water yields 257 times the heat yielded by steam. Seventh, that the heating action of water is more steady, or less fluctuating, than that of steam, and that by as much as the temperature of the water surface is lower than that of steam the quality of water heat is better than that of steam. Water heating by forced circulation is cheaper than steam only as waste may be conserved and made usable. In the initial cost and main-

tainance of the plant the water is slightly the more expensive of the two. A water plant is wholly unsuited to large mill work in which heating is required when power is not available.

The use of air as a vehicle for heat transference has certain distinct advantages over methods thus far noticed. It adds ventilation to heating. Its study brings to the front the economy of the method. Into this problem two factors enter, one is the cost of the method, the other the value of the results of the method. So far as the cost of the heat furnished is concerned it may be asserted without fear of challenge, that heating with ventilation is more costly than heating without ventilation. Before the balance sheet can be struck, however, the gain accruing from ventilation must be entered at its full value in the profit column. The initial cost of the hot air method of heating is, first in the increased price of the installation, when all expenses chargeable to it are included in the account; second, in the heating of large volumes of outside and cold air up to the point of mill temperature before anything toward mill warming can be effected. It is this last named expense of heating air up to the mill temperature, preparatory to further heating for mill warming, which makes the process costly as a method of heating alone.

The warming of outside air up to the mill temperature is profitable only on the score of ventilation, and its cost must be charged to that account. Warming that air beyond the mill temperature is effective in heating, and is properly chargeable to heating expense. Therefore, to reduce costs of warming, it is essential that the air quantity be so reduced that the expense of warming up to the mill temperature shall be small, and that the ratio of the heat given to the air above the mill temperature to that given to the air below the mill temperature shall be as large as practicable. In other words, the air volume raised to 60 degrees must be small, and the heat added beyond that temperature large. Theoretically, therefore, economy in heating favors the use of low air volume, and high air temperature.

Such a method rigidly adhered to is, however, likely to land the user in difficult and costly expense. One of the offsetting

advantages and economies of the air method of heating is that the inward pressure, or the plenum, produced reduces the inflow of cold air through walls and crevices, and so the amount of chill to be overcome. Since air supplied to a room must necessarily escape, its exit through walls and crannies is by no means a 100 per cent. loss. It is indeed, no loss at all in the matter of heating if the temperature has dropped, before escape, to the room temperature; nor, on the other hand, in ventilation, if its vitiation has risen to the room's vitiation. On the other hand, all inward leakage of cold air is a distinct loss in the heating account, for the reason that such leakage chills the floors; and chilled floors make a high mean of room temperature necessary; and this again results in a necessary superheating of ceilings, which is a further and prolific source of loss in building warming. Anything which tends to produce an unequal temperature between ceilings and floors makes against economy. A small air supply highly heated does exactly that; first, because highly heated air rises to and floats at the ceiling and only incidentally warms the floor; and second, because a small air supply does not produce internal pressure sufficient to prevent harmful inleakage of cold air. While the ceiling is being heated the floor is becoming chilled. For these reasons the apparent saving gained by the theoretically economic method above noted may be more than wiped out by the attendant loss.

Ceiling high temperatures and floor low temperatures may be prevented by several means now to receive passing notice. The hot air blast may be so entered as to induce slow moving but large volume airflow from the floor which shall mingle with the inducing current, in this manner removing cold air from the floor level and supplying air at correspondingly lower temperatures at the ceiling level. The accompanying figure illustrates a method by which the hot air blast may be prevented from producing an accumulation of heat at the ceiling and may be made to displace cold air at the floor. Let D be a duct within the building walls, and A an aperture for its escape from the flue into the room. Let F be the floor level, let W be one of

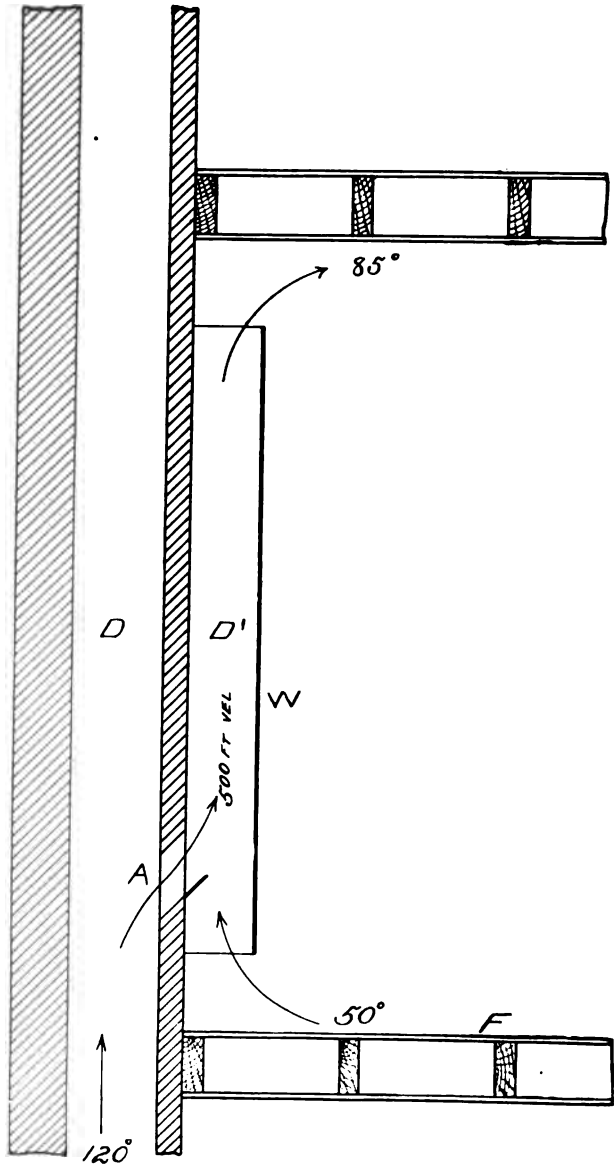


FIGURE I.

the walls making a duct D' having two or three times the area of cross section of aperture A. Let the temperature of the air in D be 120 degrees, that of the floor in the room 50 degrees. Let the hot air current have a per minute velocity of 500 feet. Let the movement of the current induce a current of the air within D' which shall have a volume double that of the air issuing through A. The result will then be that the quantity of air moved from the floor will be equal to the quantity of air issuing through A, and also that the temperature of the air issuing at the top of D' will be 85 degrees as against the hot air temperature of 120 degrees.

The peculiarity of the working of so called hot blast systems has been from the first that just described. It is one of its inherent defects. The partial remedy is in the method suggested. Its best remedy, however, is in the use of larger air volumes at correspondingly lower temperatures. The gain to be made by adopting the latter method is not to be gauged solely by the increased effectiveness of the heat used, but also and more so by the improved working capacity of the mill hands, because of the better sanitary conditions which are the result of free ventilation. It is at this point that the economic considerations entering into our subject assume their largest proportions. What relation has pure air in mills to the mill-man's profit? Simply this, the working of his plant is inevitably connected and dependent on the hands and the heads of employees. The employees are vital mechanisms, the energy, activity and alertness of which are dependent in turn on vital processes to which air is as essential as is food or drink. For the maintenance of their vital energy at its best, the quality of air furnished them is of greater importance than the quality of the food they eat. The human body is the analogue of the mill-man's mill. Give to the fires of that mill poor coal, but with a good draught and good stoking, the skilled engineer will even then furnish a full head of steam for the mill's power. But give to those fires a poor draught, then, even with the best coal, no skill or faithfulness of the engineer can supply the needed

steam. The mill mechanism and its energy producing conditions are duplicated in every employee under the roof of the mill. If the highest energy is to be developed, and the highest efficiency insured, the essentials to such energy and efficiency must be furnished.

A well known mill engineer has recently said that the cost to him of a half day's headache due to the closeness of a room might easily be $1,000. The cost of dullness, drowsiness, lethargy, physical and mental languor in employees is in the aggregate enormous. Such losses are not confined to professional offices and draughting rooms, nor to school buildings and audience rooms. The absence of alertness, watchfulness, fidelity to the employer's interests cannot be made good by the most highly developed autonomy in machinery. The working of such machinery must always suffer delay, and its production suffer in volume and quality through the inattention and stupidity of employees. The more developed the vitality of the hand, the less its false moves, slips and blunders, and the more dexterous and timely its touch, and the more productive its work. If American labor is superior to any other, it is because the conditions upon which vital energy are dependent are better furnished in America than elsewhere. The laborer is better housed, better fed, better clothed, better educated; his vital fires are provided with better draught, his whole physical and associated mental and moral being and activity are correspondingly invigorated and toned. It is, therefore, a short sighted economy which busies itself with counting the cost of the use of heat in this way or in that way for mill warming, and which weighs small air volume at high temperature against large air volume at low temperature in their effect on the coal bin solely. Brain, brawn and bin are all involved in one complex account, and the man whose range of vision is not broad enough to include them all is not fully equipped for the highest success in the industrial world.

Before leaving the subject of mill warming by air as a heat vehicle, two defects common in its application should be noted.

If air is sent to all parts of a mill at one and the same temperature and humidity, the temperature and humidity of the different parts of the mill can be controlled only by regulating the quantity of air delivered to the several divisions of the mill. Complete regulation of this character is more possible than probable. If it is done, ventilation is made subordinate to temperature and humidity conditions. Because each kind of work in different parts of a mill requires its own peculiar temperature and moisture, the most appropriate method for warming and moistening would be to warm the common air supply to the lowest temperature and to moisten it to the lowest degree called for by any part of the mill, and to supplement such temperature and moisture by a local supply of heat and vapor. Such a method would necessitate a dual system of direct and indirect heating, or more strictly, a dual system combining ventilation with heating. The actual working conditions of mills call for the use of such a method to some extent. Air properly heated for most parts of a mill needs superheating for the work of some particular part. That superheating is generally effected by heat directly or locally furnished. The average humidity desired may be and often is such that condensation takes place on the ceiling of the top floor in cold weather, that ceiling being formed by the roof boards. To prevent such condensation heating surfaces at the roof ceiling become a necessity.

A hot air blast system, pure and simple, has the one permanent recommendation of simplicity. Its limitations, however, make its perfection impossible. In operation it is analogous to the supplying of water from a common reservoir to a city. For meeting the community's needs such water is perfect, as served, for putting out fires, watering streets, washing sidewalks and for part of the drink of total abstainers and others. For the most part, however, it must be either cooled or heated for manufacturing, as also for domestic purposes, and must be put through processes of heating, mixing and other treatment before its final adaptation to its many uses is complete. When water delivered straight from the hydrant is perfect for industrial and domestic

needs, then air from a single source at one temperature and fixed humidity will perfectly meet the demands of a building having varied ventilation, temperature and humidity requirements.

The general air supply may best be tempered and moistened to the degree required by those parts of the mill in which both temperature and humidity are maintained at a minimum. It may be warmed by steam or by water, or by any other means which the conditions of each case shall make economically most advantageous. The moistening may be effected by discharging steam into the air current, or by injecting a water spray into it, or by passing the air through wet and sufficiently open material. However done, the heat expenditure in evaporation is practically the same, amounting to about 1,000 B. T. U. for each pound of water or steam used. To change the actual humidity of 100,000 cubic feet of air by four grains per cubic foot would necessitate the evaporation of 57 pounds of water, or the injection into it of that weight of steam, and an expenditure of heat equivalent to the burning of between five and six pounds of coal. If the heating and moistening is done in the rooms rather than in the air conduit, the heat expenditure is precisely the same.

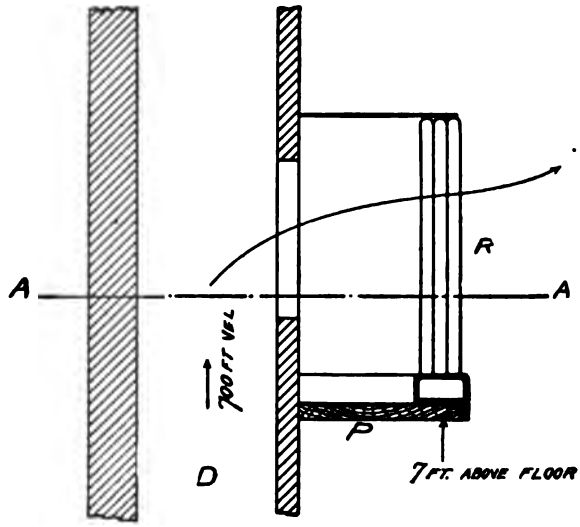
Properly speaking, air is not moistened when water sprayed into it in atomized form is not also evaporated. One of the objections to that method of moistening air is that the moisture may exist in the air as minute floating mist particles rather than as vapor. Water may in part hold this form also when steam blown into the air takes the form of fog. To more completely reduce the water to vapor form, it is advantageous to inject steam into air before its passage through heaters, the contact of water particles with the hot surface promoting evaporation. It is for this reason that the same steam which when blown into an air current after its passage through a heater has a sudsy odor, has no odor when blown into the air prior to its contact with the heater. The odor is due to microscopic or ultra microscopic water globules having a yet smaller particle of dust matter as a nucleus. When evaporation is complete the globule no longer exists, and the freed dust particles are then dry and relatively

odorless. When evaporation takes place by the contact of the water globules with the hot metal of the heating surface, the organic nucleus is liable to adhere to the surface, and both the air and the vapor to be freed from its presence.

Supplementary heat and moisture may be given to the air of a room either as it enters the room or after its entrance. The latter method is the more common in practice. The former method offers some advantages worthy of consideration. In the matter of heating, the rate of transfer of heat from a heated surface to air is affected by the rapidity of air movement over the surface. If that rate is one in still air, in rapidly moving air it may be from four to seven and upward, according to circumstances. The heating surface required for any given amount of work is inversely as the rate of heat transfer. Therefore, if the heating surface be placed in the air currents issuing into a room, the amount of surface may be greatly reduced below the quantity required were the same heating done by pipes or radiators exposed in quiet air. Reduction in surface is practically synonymous with reduction in the cost of plant.

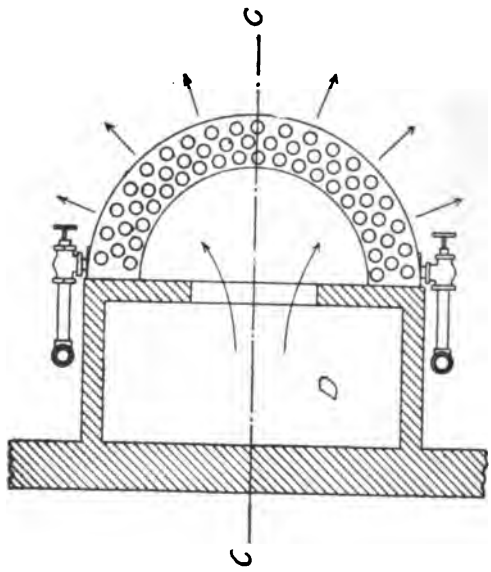
The accompanying figures illustrate a method of supplementary heating by convecting and radiating surface placed in the air current issuing from an aperture under fan pressure. Suppose the heater to be in the form of a pipe radiator, the pipes being three feet long, one inch in size and 60 in number, the total surface being 60 square feet. If the flow rate through the heater be such as to treble their heating effect as compared with pipes in still air, then 60 would be as effective as 180 square feet, or as 540 linear feet of inch pipe stretched out in the form of an overhead heater. One such heater as that described would have the capacity of warming 300,000 cubic feet of air an hour through 24 degrees F.

The effectiveness of warming by this or any method depends largely on the rate of movement of the floor air, either upward in warmed currents, or outward through vent shafts. When wall circulation below the windows is used, the floor air warmed by it rises, and the floor is thus warmed by the rotation of the



SECTION ON CC

FIGURE 2.



SECTION ON A A

FIGURE 3.

air of the room. The same is true of the method of moving floor air by mixed draught already described. In the method illustrated in the cuts, the floor air should be removed by vents at the floor level. The displaced air would then be replaced by the downward movement of the upper air strata. Such an arrangement for air issuance into the room, distribution through and removal from it would insure better and more economically obtained results than could be had by the use of overhead heating combined with tempered air inflow.

The " indirect heating " of mills is not without its mal-adaptation. It ventilates all rooms, whereas ventilation needs are as varied as are humidity requirements. Some rooms are unoccupied except by goods; others have such large per capita floor and cubic space that spontaneous ventilation through walls and window cracks furnishes an abundance of air for their uses. In other rooms the conditions are congested, or work is accompanied by the production of excessive quantities of dust, steam or heat. Again, air blast heating is inseparable from power for fan running.

The system most completely adapted to the entire range of mill conditions and requirements is to be found in a combination of fan with direct or supplementary heating. The fan is useful the year round in maintaining salubrious conditions in the operating rooms of mills, through its ability to furnish large air quantities warmed in winter and cooled in summer. Its service, or that which is its equivalent, is indispensable to the complete furnishment of an ideally equipped mill.

The maintenance and control of a mill's humidity, though a problem apart from warming and ventilation, may yet be given passing notice. An enclosure heated by direct means dries more excessively than one heated by indirect methods. The action of radiant heat is to accelerate drying in all material within the range of its action. The resulting evaporation is into the air, tending to moisten it at the expense of the material's moisture.

In the case of atmospheric moisture, the rapidity and the per-

unit-space volume of molecular movement, and the diffusion rate are therefore higher for warm than for cold aqueous vapor. The process of diffusion takes place through porous walls as well as through all large or small passages. So long as the excess of diffusion movement is from within outward, the result is one of interior drying. The process continues until the rates of outflow and inflow are in equilibrium, and until the actual humidity of the interior is less than that of the exterior air.

When this last condition is reached, the bringing into the building of outside air increases interior humidity to a limited extent. On the other hand, when it is desired to maintain an interior actual humidity considerably in excess of the exterior, the quantity of vapor artificially supplied to the air increases with the volume of air furnished the enclosure. This is because supplying air to the enclosure means the removal of an equal quantity from it, and the removal of air is necessarily accompanied by the removal of the contained moisture also.

The quantity of vapor needed to moisten any quantity of air through any actual range may be easily computed. One pound of vapor would furnish one grain to each of 7000 cubic feet. To bring outside winter air at 30 degrees R. H. 50 to R. H. 70 at 70 degrees makes necessary the evaporation of 4.6 grains per cubic feet of air moistened, or 4.6 pounds of water evaporated for each 7,000 cubic feet of air furnished. In case of a room 50 x 150 x 15 feet, the air of which is changed three times an hour, the vapor quantity to be furnished the air would, on the above basis, be $\frac{50 \times 150 \times 15 \times 3 \times 4.6}{7000} = 222$ pounds per hour. To evaporate such a quantity by the exposure of water or wet surfaces, even if exposed to rapidly moving air currents would be impracticable.

From a water surface exposed in still air at 70 degrees R. H. 40 the evaporation rate per square foot would be one thirty-eighth pound per hour. The extent of surface needed for the amount of evaporation above named would, therefore, be in excess of 8,000 square feet. By passing the air over the surface

in a sufficiently strong current, the evaporation rate may be increased to ten times that obtainable in still air, and for the evaporation called for the surface would be proportionately reduced. The most effective methods for air moistening are the injection into the air of fine water mist, or of steam. Of these two methods the steam is preferable in winter when the slight warmth gained is advantageous, and the spray in hot weather, if at such time moistening is required, when the decided cooling produced tends to comfortableness.

As heretofore observed, when steam is used it is better to inject it into the air before its passage through heaters than after such passage. In cases where supplementary heaters are used in the manner previously described, the steam may be supplied from the riser or branch furnishing steam to the secondary radiator, and may be injected into the air current as it passes through the aperture *A*.

Passing from the textile department of mills to the printing and the dyeing rooms, the importance and the difficulty of proper ventilation increases. Excessive quantities of heat and considerable vapor are given off in the processes of printing, and excessive quantities of vapor and considerable heat in dyeing.

Such rooms may be treated in two radically different ways. By one method the vapor and heat may be allowed to escape into the room, the air of which is kept as cool and as clear as practicable by forcing fresh and dry air into and through the room. By the other method the heat and the vapor are, as far as practicable, prevented from escaping into the room and are removed as quickly as formed by exhaust fans or shafts. One method is by limitation through removal, and the other method is by diffusion before removal. In economy and effectiveness the method of limitation is greatly superior to that of dilution.

Two possible ways of warming and ventilating a room by an open fire illustrate the merits and demerits of the two methods. It is possible to attempt the warming of a room by building the fire on the center table rather than on the hearth, and also the

keeping of the room free from smoke in both cases. The task in one case is difficult, costly and but partially effective. In the other it is easy, inexpensive and effective. With the fire on the hearth the smoke may be completely removed by one-hundredth the air flow required to even tolerably free the air from smoke when the fire burns on the center table. What is true of the smoke in the parlor is equally true of steam in the dye house, and of heat in the printing room. The first essential is to limit vapor and heat to the place of their origin, to prevent their diffusion through the air of the entire room, or through any part of that air outside the construction designed to confine them. The next requisite is the providing of a current of sufficient volume and strength to remove such heat and vapor as rapidly as given off from the goods or by the dryers. The air of the room may then be kept as free from fog as is the outside air, and free from all heat which air currents can arrest and remove. Radiant heat cannot be limited and carried by air currents.

A dye house when in operation is a humid and often hot place. To blow hot air into such a house for the purpose of diluting and removing the moisture would necessitate the expenditure of large heat quantities which would add to the torments of the room. To blow the premises free either of hot vapor or of chilled fog would require an air flow in volume and movement which would result in annoying if not dangerous draughtiness. To gather the vapor rising from the vats into suitable hoods, and to hold it there until removed by exhaust discharge draught would require hardly a third of the air needed for the blowing out process and but a fraction of the heat necessary to obtaining results far inferior by the other method described. Moreover, where, as in some cases, the vapor may be confined and removed with the use of a small amount of air, and at a high temperature, it is then possible to obtain from it the latent heat of evaporation of its contained moisture, and by means of it to warm the air used for the ventilation of the dye room. In illustration of a method proposed some years ago by the author for effecting such economy, the following extracts

are made and figures taken from a paper on paper-mill ventilation, published in the *Technology Quarterly*, May, 1888.

"It may frequently be possible to draw the air supply through the rooms adjoining the machine-room, so affecting both their ventilation and the heating of the air in transit. The additional heat yielded by radiation from the machine driers and piping may then be sufficient to maintain the desired temperature, making large auxiliary heating surface unnecessary. Adequate means must be provided for the heating of the machine-room without ventilation when the machine is not running.

"The cost of ventilation may, however, be greatly reduced by the use of suitable means for affecting a transfer of heat from the discharged air and vapors to the air supply. The heat contained in the 400,000 cubic feet of discharged air and the 830 pounds of water vapor contained in it is greatly in excess of that required for heating the fresh-air supply, even in the coldest weather. Cooling the escaping air through only 20 degrees the yielded heat would equal 218,000 units, and a corresponding vapor condensation would yield 400,000 more, making a total of some 600,000 against a maximum of 500,000 needed for zero weather. To affect the transfer the discharged air may be made to pass through a battery of galvanized iron pipes, over which the supply air is made to pass by the aid of an auxiliary fan. A possible and convenient form for such an arrangement is shown in figure 4. The ventilating shaft V, through which the discharged air escapes under the unaided action of its own levity, or preferably by the aid of a fan, F, has a cross section of three feet six inches, by three feet six inches. By means of a damper, D, the air movement may be deflected from a straight course through the flue, and passed wholly, or in part, through the transferring arrangement, according to the quantity of heat to be transferred to the incoming air. The boxes, B B, are eight feet by two feet, and they are connected by 144 pipes of four inches diameter and twelve feet in length, twelve of which are shown. A diaphragm, G, separates the free space between the boxes into two equal parts, the air supply being thus made to pass twice and in reverse directions between the pipes.

"Figure 5 gives a vertical section of the arrangement from another side, C G C being conduit chambers extending across two sides of the battery of pipes, and designed to facilitate the equal diffusion of air over and movement between the pipes, which should be spaced eight inches between centres and in staggered order. For greater convenience in handling, the pipes may be made in two parts, one telescoping

into the other, and soldered as they are placed. The lower length of each pipe should be made to extend a half-inch or so into the lower box, to prevent the wetting and rotting of the wood, and the pipe should be supported by a flange. A similar flange may be placed at the

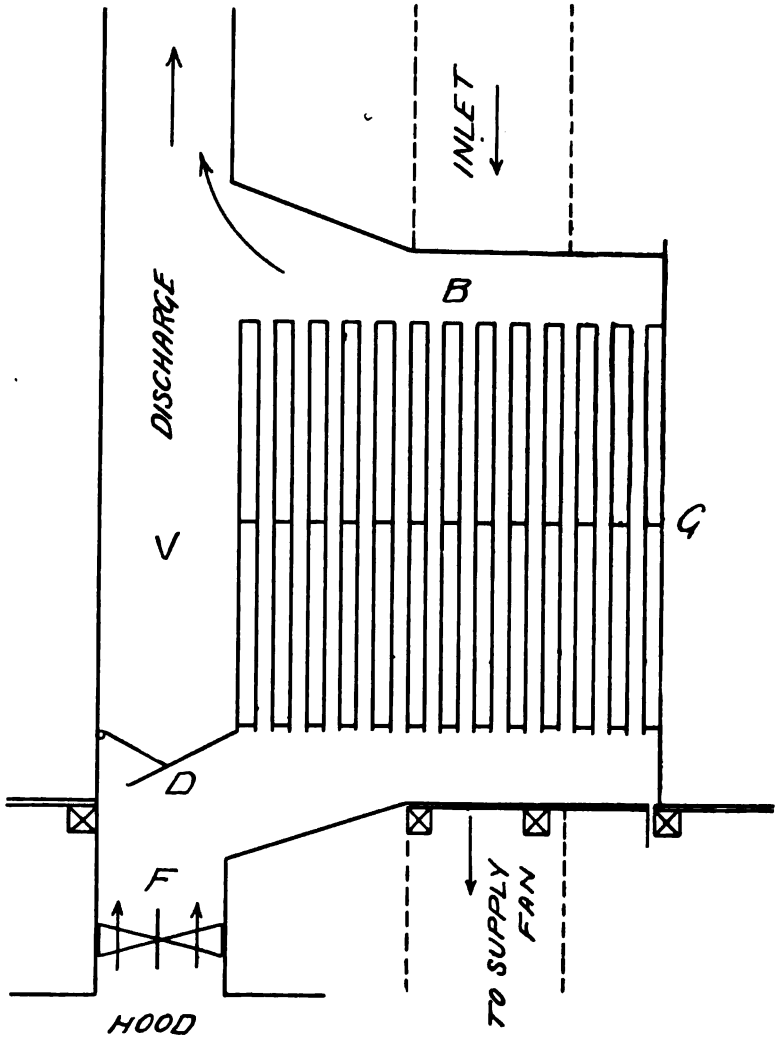


FIGURE 4.

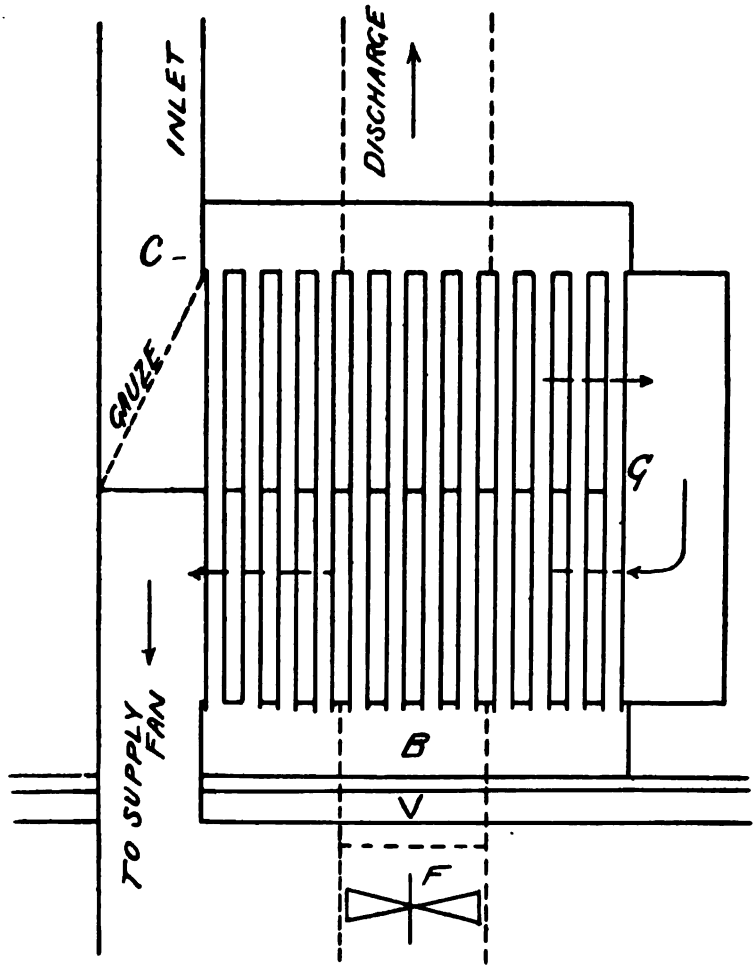


FIGURE 5.

top of each upper length of pipe, to aid in making a tighter joint. The bottom of the lower box should be metal lined, and arranged for the drainage of from 35 to 60 gallons of condensation an hour.

"The cost of such a heat transfer, with fan and air connections, would be no more than the steam-heating plant otherwise required, and the expense of using it would be that of running a one-horse power

fan, costing in coal perhaps five pounds per hour if the exhaust steam is thrown out-board, and less than half a pound if the waste steam is used for any mill purpose. The gain would therefore be practically the entire cost of the coal otherwise required for heating, and the principal item of loss would be in the space occupied by the system, eight feet by twelve feet on the floor and sixteen feet high. These dimensions may, however, be reduced without effecting a corresponding reduction in the efficiency of the transferring apparatus.

"The economic value of such a method of transfer increases with the difference in temperature between the outdoor and the discharged air, with the humidity of the discharged air, with its volume, and with the increased cost of fuel. Its application to the ventilation of ordinary buildings cannot have the economic value which may be realized when the discharged air is of excessive humidity. When the new building of the Massachusetts Institute of Technology was in process of construction, the writer suggested the adoption of a plan for economizing fuel by the transfer method. The proposed plan would, according to estimates furnished, have required an outlay, in modification of building and in special construction, of some $12,000 or $15,000. The saving in coal would, by estimates, be at least from 150 to 200 tons a year. The interest on $15,000 at five per cent. equalling the cost of 150 tons of coal at $5 per ton, the gain under such conditions would be nothing. Yet in buildings of such character and use as are maintained by individual or governmental endowment, the adoption of such a plan might be in the line of economy, since the needed funds for its installation as part of the building's equipment could be much more easily obtained by solicitation than its equivalent annual gift for the purchase of coal."

The principal difficulty experienced in the case of dye houses would be in effecting an arrangement or grouping of the vats in such a manner as to give needed access to them, and at the same time to so bring them under the vapor collecting hoods as to insure the retention and removal of vapor. Where such a method is not applicable, and where the vats must be exposed in open rooms, the most effective method of ventilation is in providing free escape at the ceiling, or roof, and as nearly above each group of vats as possible, and in liberally supplying the room with air through its floor, and in as diffused a manner

as possible. The natural current from each heat and vapor producer will then be upward and outward, and the dryer and cooler air, because of its greater specific gravity, will remain at or near the floor until given its turn to serve as a vehicle for removing the wastes. Under the best arrangements of this kind possible the modus operandi and the results must be like those in the parlor when the fire is burned on the centre table rather than on the hearth.

Two arrangements for ventilating print work rooms are illustrated in the following sketches. The evolution of moisture in such rooms is not such as to produce troublesome fog. The heat is high and humid. The machinery is bulky, occupying large floor space, and stands high. The heat and vapors are yielded through proportionately large surfaces. They cannot be concentrated and gathered and removed as easily as when rising from a boiling vat, or even from a paper machine. Diffusion of hot air and contained vapor is almost a necessity. The treatment must therefore have reference to producing such a movement of air in quantity and direction as shall protect the operatives at the head of the machines.

Let figure 6 represent an elevation section of a basement printing room having east and west windows, and a high storage room above it. In the first instance, suppose the storage room floor to be tight from wall to wall. The heat in the basement would then be oppressive and the floor over the operative's location at S would probably be cut away. The resulting relief would perhaps be sufficient for the winter conditions. In summer, westerly winds through the open windows would move the air over the machinery, and its acquired cumulative heat would be intense when it reached the head. Fans might then be placed in the loft of the storage room to accelerate the air flow. That flow would still be in a direction to carry the accumulated heat with added sureness to the very point the attempted ventilation was intended to relieve.

The remedy is, first, to close the westerly windows and to stop the air current which, gathering all the heat and moisture

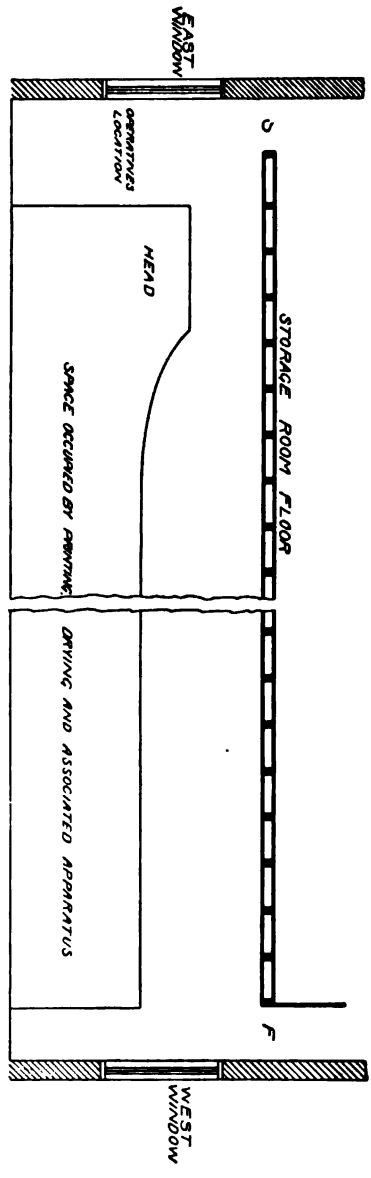

EAST WINDOW
OPERATING'S LOCATION
HEAD
SPACE OCCUPIED BY PRINTING
STORAGE ROOM FLOOR
DRYING AND ASSOCIATED APPARATUS
WEST WINDOW

FIGURE 6.

it can appropriate in transit, carries it directly to and pours it upon the already wilted operatives at the head of the apparatus; second, to cut away the floor at F, and to carry a large duct from F to a discharge fan capable of producing so steady and large volume flow of air from east to west that the cumulative heat movement shall be away from the operatives, and the air flowing onto them shall be cool air from the east window, or falling through the floor space S.

The problems in mill heating and ventilating are varied, and many of them difficult. For decades and centuries men have, with varying degrees of success, been working at their solution. It would be only a conceited conception which would allow any man to assume that he held the key to their complete and perfect solution. No student or worker can do more than contribute something by way of suggestion or demonstration to the progressive betterment sought. The thing of first importance is a clear apprehending and setting forth of the fundamental principles involved. That of second, if not equal importance is the correct and therefore successful application of these principles to the practical problems of industrial work. Both are essential to profitable theorizing and practice. It is because one or both are wanting that in many instances unnecessary and in some cases large losses are incurred by vague reasoning and blind experimenting.

It is the part of the technical school to put men trained in correct theory and practice at the service of the industrial world. To the several sources of waste already mentioned, the stoppage or reduction of which can mean increased profit, there is perhaps another, namely, that due to a lack of appreciation of the services technically trained men may render. Technical schools exist for the manufacturers' benefit, for the developing and perfecting of methods, for the promotion of industrial economies. If such schools fail in that function one of the highest services that manufacturers can render is to make the fact effectively known. To the extent to which they do perform that function it behooves the industrial producer to keep himself in close working touch with such institutions and their graduates.

Mr. C. J. H. WOODBURY. This is the second time that this Association has been indebted to Professor WOODBRIDGE for giving it the results of his opinion upon heating and ventilation, the former instance being a paper on the Ventilation of the Machine Rooms of Paper Mills, which appeared in the Technical Quarterly in May, 1888, copies of which were distributed to members of this Association. That was one of the earliest papers on the practical application of methods of the removal of vapor from the upper parts of rooms which were very foggy in winter, notably dye houses and bleacheries, and I believe that it is more to Professor WOODBRIDGE than to any other man that the manufacturing community is indebted for the development of improved methods and the dissemination of exact knowledge upon the costs of heating and ventilating and also to a great extent its commercial value in taking better care of help, and this principle applies to everyone in buildings, especially during cold weather, whether it be at mills, commercial buildings or at our homes, and I trust that this paper when published in the Transactions, will be carefully read, anticipating that it will be of as much value to the members of the Association as was his former paper.

VICE-PRESIDENT FRED C. MCDUFFIE in the chair. If any gentlemen desires to discuss the matter of warming and ventilation of mills, such discussion is now in order.

Mr. EDWARD ATKINSON. Let me state that Professor WOODBRIDGE has dealt with one or two of the hardest cases that have ever come under my knowledge and has successfully covered the point. You all know that in the Fourdriner machine room, there is great excess of moisture to be removed, so that it is one of the most difficult places to ventilate, and he has dealt with two or three of the worst cases with entire success.

The VICE PRESIDENT. Will you have any further discussion of this subject, gentlemen? If not, it will be in order to pass on

to the topical questions which you will find on your program, the first being

121. What can be offered on the subject of the influence of moisture in the air affecting the strength of yarn?

Mr. FRANK P. VOGL, Claremont, N.H. I submit the following table, which I have kept for over two years, as showing that strength of yarn gains with the increase of humidity. I also enclose a test of yarn made at Naumkeag Steam Cotton Mills, Salem, Mass., and the test of some bobbins here the following day, the conditions of weather and wind having remained the same, although I did not have any means of getting humidity of atmosphere at that time. Our yarn is tested daily and I get average of the month for my table. Comparison of strength yarn at sea level and at 700 feet above sea, being test of same yarn at Salem, Mass., and Claremont, N. H., showing increase of strength at sea because of humidity of atmosphere.

Naumkeag Mills, No. 22 Warp. Salem, Nov. 6, 1895. Warm and windows open, 2 P. M.				Naumkeag No. 22 Warp. Claremont, N. H., Nov. 7, 1895. Warm and windows open, 2 P. M.			
No. 21.74	strength	85	lbs.	No. 21.79	strength	85	lbs.
21.05	"	97	"	21.10	"	81	"
20.62	"	84	"	20.92	"	92	"
21.05	"	89	"	20.62	"	84	"
4)84.46		4)355	"	4)84.43		4)342	
21.11		89	"	21.11		85½	"

CLAREMONT, N. H., FROM DAILY TESTS, NO 22 WARP.

MONTH.	1898.			1899.			1900.		
	Average No.	Pounds Strength.	Degrees Humidity.	Average No.	Pounds Strength.	Degrees Humidity.	Average No.	Pounds Strength.	Degrees Humidity.
January,	22.36	71½	33.38	21.73	73¾	31.00	21.29	71½	41.42
February,	21.82	73	34.50	21.63	74½	33.18	21.85	72½	41.45
March,	22.03	72¼	32.62	21.90	72	41.00	21.98	68½	32.60
April,	22.28	74¼	35.66	21.39	75¼	38.00			
May,	21.87	85	46.90	21.81	77	42.00			
June,	22.23	85½	46.00	22.31	79¼	44.92			
July,	22.58	83¼	46.62	22.00	83½	45.00			
August,	21.87	86	49.63	22.46	80	45.40			
September,	22.05	82	42.91	21.80	81	43.70			
October,	21.70	81½	42.00	22.05	81¼	43.50	After Nov. 1 is this		
November,	20.76	80	38.45	22.20	75½	40.46	year's cotton, and it		
December,	21.55	75½	32.32	21.87	70¾	40.87	has weak staple.		

The VICE PRESIDENT. If there is no further discussion, we will pass on to

122. What is the best temperature and humidity for good spinning on fine counts?

123. What is the best way to prevent double yarn on spinning frames where double boss rolls are used?

124. What is the best covering for the top rolls used on frames and mules that are to spin various numbers?

125. What is the best taper or length of wind for mule cops on number 37 filling?

126. Is it practical to spin numbers finer than 65s on larger rings than 1½ with spindle running 9,000 revolutions?

As there does not appear to be any further discussion on these topical questions, there is no further business before the Association at this session.

Mr. WALTER E. PARKER. Mr. President, I move we adjourn until tomorrow morning at 10 o'clock.

The motion was seconded by Mr. JOHN H. PARKS and was carried, and the session was thereupon adjourned.

THIRD SESSION.

THURSDAY MORNING, APRIL 26, 1900.

The Association met in Chipman Hall at 10 A. M., President THOMPSON in the chair.

The PRESIDENT. Gentlemen, we will proceed with the business of the morning session, in which the first matter is a paper relating to Systems of Payment on Mules, by JOHN B. CUDLIP, Marysville, N. B.

SYSTEMS OF PAYMENT ON MULES.

JOHN B. CUDLIP, Marysville, N. B.

The three general methods of paying mule spinners in force throughout the country are: daily wages; so much money per pound of yarn spun; and so much per hank per spindle as indicated by the hank clock on the front steel roller, or the number of stretches as shown by the back shaft stretch indicator. The system of paying by the day is in quite general force, and while there are some decided drawbacks to its use, yet under favorable conditions it works about as well as a piece-work system. One trouble with the standing pay system is that in rooms where it is in force the overseer will generally find it more difficult to get the maximum production from the mules at all times, because the feeling that the pay is there whether the mules run or not is very apt to make the spinners who are a bit lazy rather slow about keeping their mules running during working hours, and when the work is spinning badly they are perhaps more liable to anchor up their mules in order to get straightened out, than to put up a fierce effort to get their work up and keep their mules going. These objections do not amount to a great deal or carry much weight in thoroughly well run rooms; more especially is this true of good hosiery yarn mills where really bad running work does not occur very often. Where there is a great deal of changing both in numbers and roving, such as there always is in a colored mill making a wide variety of goods and spinning its filling out of stock-dyed cotton, the simplest and probably the best method of payment is to give standing wages. When piece work is in force in a room of this descrip-

tion it is a great deal of work and more or less difficult to keep track and make the proper allowances for all the changing.

In rooms where so much per pound is paid, the most general way to get at the pounds spun by each spinner is to weigh off the work from each pair and deduct so many pounds as the average tare for the weight of each box, or by taking the actual weight of each empty box, which has been weighed and marked when new. A great objection to this system is the large amount of labor involved in doing the weighing, and the fact that it is almost impossible to keep the tare of the boxes right. In handling the boxes, and especially when they go into the steam chest, after a few weeks' or months' use you will find a good many boxes with pieces broken off, or perhaps they have been repaired by nailing a false end in, thus the boxes are lighter or heavier than their accepted weight. The spinners realize this very keenly and as a result the longer headed ones are constantly on the alert to secure good heavy boxes. While there may not be a great deal of actual loss to the mill, in fact if the boxes are light the mill gains that much, yet it is a rather dear gain for it certainly gives the spinners more or less good grounds to consider themselves a little unfairly treated in the matter. There is another side to this method of paying which is, that a mule may be changed a tooth or a number of teeth lighter or heavier on the draft pinion, and the yarn still be called the same number for convenience. When this is done it is somewhat unfair to either the mill or to the spinner. Where the change is made on the light side the spinner knows he has to run his mules so many stretches more to get the same number of pounds; on the other hand when the change is made on the heavy side the mill is really paying more than the agreed price per pound for the spinning.

In the system of payment by the hank clock on the front roll or the stretch indicator on the back shaft, there is no possibility of a mistake in getting the product of the mules unless the overseer puts down the figures incorrectly, and it is impossible for the spinner to beat the mill by turning his clock by hand when

the mule is stopped, because the Orme indicators now have a cast iron housing attached to the clock, through which the end of the steel roller carrying the driving worm runs; from the nature of the construction of the back shaft indicator it is impossible to monkey with it and show more stretches than the mule has actually run. This feature of absolute truthfulness is an extremely valuable feature to the mill, as it insures that the mill records show only the actual work done, and that the spinners have only been paid for just what they have spun.

The back shaft stretch indicator is more correct than the front roll clock in showing the work actually done by the mule. This is so because it is not affected by changes in the adjustment that do affect the hank clock. The front roll clock is directly affected by the amount of drag put in the yarn, and on fine work by the length of jacking. On coarse work the front roll will deliver from two to four per cent. greater length than the actual length of yarn in the stretch—the amount of contraction varies with the coarseness of the yarn, turns of twist per inch, and the quality of the stock; this over-running of the roll is registered as hanks per spindle by the clock. On the stretch indicator it doesn't make any difference, as far as the correctness of the record goes, whether the drag is increased or diminished or more or less jacking put in. A stretch is a stretch, and every time one is registered it means that a certain definite amount of yarn has been spun and wound on the spindles.

In paying by the indicator or clock there is no need to bother about a slight change in the yarn either on the light or heavy side unless the speed wheel of the mule is changed so that it will run slower or faster.

The objection most generally urged against a hank clock is that if a spindle is stopped the clock still goes on registering just the same as if the end were up and yarn being spun. This objection is certainly true, but it is also true that where many ends are allowed to be broken back there is something besides the hank clock at fault, and the remedy of the trouble doesn't

lie in a different system of getting the mule's product, but in a change in the way the room is run.

The hank clock is so arranged that it registers two and a half per cent. less length than actually delivered by the rolls. This is supposed to cover the loss caused by ends down or spindles temporarily stopped. As a check on the accuracy of the clock I have had the product of different pairs of mules most carefully weighed and the weights checked to make certain there would be practically no chance of error, and, on ordinary carded work medium counts, found the result invariably come within a few pounds of the product as figured from the clock.

In mills where there is a good deal of changing and the piece-work system is in force it is necessary to arrange a standard price to be allowed whenever a back of roving has to be changed; in some mills it is necessary to arrange a price to cover changing the back of roving and altering the distance apart of the steel rolls. The best method of payment for mule spinning for the mill to adopt is that one which will under its conditions of working help to give the largest quantity of good work with the smallest chance of error in computing the production of the mules each week. The system that I have found come the nearest to answering these conditions under average circumstances, is paying by the clock.

The PRESIDENT. The next paper is Methods of Cost Finding in Cotton Mills, by WILLIAM G. NICHOLS, Chester, S. C.

The SECRETARY. Mr. President, this paper of Mr. NICHOLS is a second one, and as such, part of a series of considerable value on the question of cost-finding in cotton mills, and it is desired by the Board of Government that the Association will take up the discussion of the two papers together at a future meeting.

METHODS OF COST FINDING IN COTTON MILLS.
(SECOND PAPER.)

WILLIAM G. NICHOLS, Chester, S. C.

METHOD IV.

In a mill having a wide variety of product, the conditions are usually different from those obtaining in a small mill or one engaged in the manufacture of yarns or one or two classes of goods.

First, in the nature of the case, it is usually a large mill, having numerous mill buildings and filled with machinery in all conditions of wear, and sometimes not the best adapted to work produced.

Second, in a small mill one efficient clerk will keep a written or mental record of everything that goes on. Can check freight bills and invoices, make up pay-rolls, enter reports and make up tables of production, etc. In a large mill, the organization is, or should be more complete, the systems of reports arranged so that a close watch may be kept of the expenses, the condition of work in process, production of machines, and rate of progress of orders. Accounts in the offices and departments are kept by those who are expert in this work. A record is thus made of many facts and data, which are useful or necessary in the actual subdivision of expense.

There is thus available a large amount of the information necessary to the minute division of outlay, and the skill and practical knowledge for its classification.

Most of the data necessary for such a system of cost-finding

as the following, are recorded as the work progresses, and used in making up pay-rolls, reports of production, etc.

By recording these facts in such a way that they are available for cost-finding, much of the apparent labor of such a method as this is eliminated. The items are on record, somehow. They should be arranged so as to be utilized.

In discussing the matter of cost dividing, one frequently hears it stated, that expenses should be divided as if all a mill were run on one class of work. This is right as a principle, but when we attempt to apply it we find practical obstacles. Suppose an establishment, one part of which is used for the production of fine goods and another for cloths of a much coarser grade. If all the mill were turned to the making of the coarser goods, there would be a relative loss in the quality and quantity of production, and a more than corresponding increase of cost. There must therefore be divised some way to carry out the theory underlying the principles. Let us change the statement to the following: Expenses should be divided in the proportion which they are incurred by the machinery engaged in making each class of goods. If this be correct, we have then reduced the problem of the division to the analysis of the expenses of manufacture, and the method of computing the same. And the more easily and simply this work can be well done, the more promptly will results be secured after the books are closed.

However, if one undertakes to obtain accurate results, a considerable amount of detail and clerical labor is indispensable.

The present paper is a sketch of method for the determination as far as may be practicable of the costs of manufacture in an establishment making fine and coarse organizations, both white and colored, selling a part of its product as yarn, buying other kinds of yarn, and using various kinds of stock for different qualities of goods.

It will seem to some that these conditions are extreme, and beyond likelihood of any actual occurrence. But while extremes are purposely selected, they are not more varied than existing conditions in more than one plant in New England.

We may suppose that a certain plant has been in operation for six months, and has produced the goods scheduled below Let us first glance at the physical condition of the mills. It is in part old, part new. The older portion of the earlier style of mill architect is driven by water power. The later mill is driven by steam, is of modern construction, so far as the circumstances will allow, and fitted with machinery in good condition. There is a finishing department for the colored goods, while white goods are disposed of in the grey, warehouses for the storage of cotton and goods, and tenements for the operatives.

When the accounts are made up, it is found that goods have been produced to the following amounts and with the accompanying particulars.—Table A.

The first four columns give necessary data of the organization. Column 5 states the percentage of the cloth which is warp, and that which is filling. In computing this the number of the yarn should be taken from the average weighings of the six months, and not as the nominal number, given in column 4.

If the weight of the cloth from the loom, given in column 3, be multiplied by the percentage of warp or filling in the cloth, it will give the pounds of yarn which are necessarily used in its production. These are extended into columns 9, 10 11, etc., and as the same kind of yarn frequently has several uses, the footings of these columns give the total amount necessary.

Having obtained this schedule of the output of the mill, we next take up the statement of expenses and income.

An examination of manufacturing costs will disclose that they may be divided into three classes.

First, material or stock. That is cotton of various grades, waste or yarn used.

Second, labor of manufacturing.

Third, those miscellaneous and general expenses such as repairs, supplies, sizing materials, power, insurance, taxes, depreciation and administration.

Taking these in the order mentioned we have first to deal with

THE COST OF STOCK.

It is impossible to make accurate estimates without knowledge of the quantities of stock used and goods produced. In this method the woven goods are all weighed in the grey, immediately after weaving, and yarns sold are of course weighed for sale. A table showing the pounds of yarn sold, or necessary for making each kind of goods, as shown in Table A, but classified according to the grade of stock represented, is first prepared as follows: (Table B).

It will be noticed that there are five kinds of stock used.

Gulf cotton	for warp,	at an average cost of	7	cents.
Upland cotton,	" filling,	" " " "	6.80	"
Egyptian cotton carded,		" " " "	14	"
Egyptian cotton combed,		" " " "	14	"
Waste,		" " " "	4	"
Yarn purchased,		" " " "	80	"

As is frequently the case, something in the way of economy in stock is sacrificed for the purpose of using as few grades as possible, avoiding constant change, and risk of running short of some grade.

It is not sufficient to take for granted that so many pounds of yarn required, have made the pounds of yarn required and used in weaving or otherwise. In mills making a large variety, the stock on hand changes so much as regards quantity and quality, that this fact must be taken into account. For instance, in taking this account of stock in process, at the close of the six months it was found that there were 5,200 pounds of No. 50 combed yarn on hand over the last inventory. Briefly stated the process of finding the cost of materials, is as follows:

First, obtain the total amount and cost of each grade of stock put in process.

Deduct from this, at the present value, the amount in pounds and dollars, which this inventory shows over the one last preceding, or vice versa.

Deduct in each grade of stock, the value of waste made. If the waste from one class of stock has been used for another, it

should be credited to the grade where made, and charged to the other grade, where it is consumed.

Divide the cost of each grade as now obtained, by the pounds of yarn made as shown in Table A. If more than one grade enters into a fabric, the proportionate part of each is taken at its own price.

In obtaining the value of stock on hand, a table is convenient and it is also useful in affording detail required in finding the labor cost.

THE COST OF MANUFACTURING LABOR.

By the term "Manufacturing Labor", it is meant to define only that labor bestowed upon direct manufacturing operations such as carding, dyeing, and weaving, and not the labor expense of repairs, power, and other departments equally necessary, but not handling the stock in process of conversion into yarns or fabrics.

As in determining the cost of material, the first operation is the preparing a statement of product, the same plan is followed in determining the labor cost, and a table should be prepared summarizing all these labor costs that none may be omitted in the distribution.

The labor cost in some departments of a mill can be separated each to its own mark of goods, much more easily and accurately than in others. As a rule this is the case the further toward completion the goods have passed.

For instance, on the cards material may go through in the same manner, to be used for fine or coarse work, as it passes to the roving frames, part of the same hank roving may be used on spinning frames, and part put behind a finer roving frame for another operation. The yarn made in the former case may be used in a dozen grades of goods, which may each receive separate treatment in weaving, and further divided by particular treatment in finishing.

The methods of getting at the cost will therefore vary in different departments. In general they may be defined as a divi-

sion and classification of the pay-rolls, at the time the labor is performed and the pay-roll made up, and a summary of the results at the end of the half year.

In the card room this is effected by the notation on the pay-roll in a column provided for the purpose, of the occupation of each employee, and if more than one kind of work passes through the room, the kind each employee is engaged on. When the work has reached the slubber and roving frames, a record is kept of the hanks or pounds produced at each hank roving, whether fine or coarse, and the wages paid for producing it. If any frame is changed from fine roving to another, a corresponding note is made of the time it was done, and the length of run on each hank.

These amounts are posted from each pay-roll to a sort of ledger that they may be added at the end of the six months. At that time, also, the wages of employees on pickers, cards, and drawing frames are added.

If we now wish, under circumstances existing in this mill, to ascertain the card room cost of making the warp yarn in the print cloth, we proceed as follows, taking the data from Table A. Yarn 28, from 4.2 hank roving, made on fly frames supplied by 1.5 hank roving made from .6 hank slubber roving. We find the total amount of yarn made from .6 slubber roving, which was consumed in making the woven product and yarn sold, from Table A, to be 1,700,254 pounds. Next find how the stock in process at the end of the half year compares with the stock at the beginning from tables previously referred to. It will be necessary to compare the weights of .6 hank roving and *the aggregates of all rovings and yarns in all operations previous to woven cloth where said yarns are made from .6 hank.* We may suppose this is found to be 35,000 pounds more at the end of the six months than at the beginning, which should be added to 1,700,-254 as these 35,000 pounds of roving have been made above what was used in cloth produced, etc.

The cost of this card room thus far is summarized from the pay-rolls, as follows:

Oversight,
Section hands, grinders, strippers,
Railway and drawing tenders,
General, scrub, elevator,
Slubber tenders,
Doffers,

Total cost divided by 1,735,254 equals cost per pound of *carding* .6 hank roving.

Next find the additional charge for running this through the intermediate frame, making 1.5 hank roving. From Table A, we may find that 509,436 pounds of 1.5 hank roving was required for goods produced, and from tables not shown, that the excess of stock at the close of the six months was 10,000 pounds. Total 519,436.

The pay-rolls show the following costs,

Section hand,
Intermediate tenders,
Oilers,

Here we first encounter the problem of dividing the expense of overseeing and those general duties which have no direct relation to any particular class or grade of stock or machinery, but have usually to do with the care of the rooms, such as sweepers, elevator hands, water carriers, and that third genus of employees, such as roving carriers, oilers, doffers, band boys, etc., who have to do with machinery running, perhaps, on a dozen different kinds of work, and in a way that makes it impossible to do better than to estimate the equitable division of the expense.

There are one or two principles which may guide us in making these divisions.

First, that those who work about the room and in the keeping of machinery in condition for service, as section hands, oilers, and scrub women, are independent of the product of the machinery and their wages should be divided according to the machines or spindles treated.

Second, the case of doffers, roving carriers, filling carriers, etc. is a different one; their number is proportioned more nearly by the amount of work produced by the machinery, and not by the number of machines themselves.

A roving frame on 20 hank will need as much oiling as one on 2 hank, but it will have no use for doffers. The best rule for the division of such labor, therefore, is in the ratio of production in pounds.

Third, overseers, second hands and book-keepers in large rooms have to do with the quality and quantity of production, but more directly with people than machines. And while it is true that one alley boy may need more watching than the best slubber tender, all things considered, it is perhaps as fair a rule as any, to divide such expense last of all and apportion it as all other labor divides itself.

After the same manner we find the amount of 4.2 hank roving to have been 509,436 plus 10,500 pounds equals 519,936 pounds.

And the cost of running over fly frames

Section hand,
Fly frame tenders,
Doffers,
Roving hands,
Sweepers,

Total cost on fly frames divided by 519,936 pounds equals cost per pound.

We may thus tabulate the labor cost of making 4.2 hank roving.

	cents per pound.
Carding,	" " "
Slubbers,	" " "
Intermediates,	" " "
Fly frames,	" " "

But there are 35,000 pounds of stock on hand in process, above the stock six months ago, which has passed through the

operation of carding in this room. It has been stated, previously, that this along with other kinds, has already been placed to the credit of the stock used, and it is carrying out the same practice that these 35,000 pounds are made a part of the divisor for finding the cost per pound.

In fact, the increase of stock in process is credited to cotton account, before the books of the corporation are closed, and the labor expended on this 35,000 pounds together with other similar labor is credited to the account of manufacturing labor as being a valid part of the inventory. In the same way dyestuffs expended on stock in process are placed to the credit of dyestuffs account.

TABLE E.

CARD ROOM STATEMENT, SIX MONTHS ENDING.....

Operation.	Size Hank Roving.	Pounds Made.	Pay Roll.	Remarks.		Labor Account.	
Picking,		2,880,000	$2,877.94			Cr.	$ 7.26
Carding No. 1,		1,800,000	5,506.18			Cr.	45.37
Slubbing No. 1,	.6	1,735,254	1,785.24			Cr.	35.00
Intermediates,	1.2	935,000	936.00	760 spindles	1280	Cr.	14.72
"	1.5	549,876	660.66	520 "		Cr.	11.00
Fly frames,	3.	930,000	2,040.61	spindles	3840	Cr.	44.00
" "	4.2	550,376	1,293.59	"		Cr.	26.25
Jack "	9.	151,000	907.28			Cr.	30.00
Carding No. 2,		1,035,000	2,810.26	Average Cards 50	70	Dr.	25.87
" for Combing,		157,784	1,262.27	" " 20		Cr.	41.60
Combing No. 2,		157,000	1,184.00			Cr.	39.00
Slubbers No. 2,		1,040,000	1,305.00			Dr.	12.00
Intermediates No. 2,		1,045,000	1,960.00			Dr.	9.00
Fly frames No. 2,		770,000	1,930.09			Cr.	9.60
Jack " "		77,000	626.29			Cr.	
			$27,085.41				

Table E shows the summary of the card room pay-rolls for the half year. This shows the total cost of the various operations in this department, arranged so that we may separate the cost of each step in the progress of the work. It is supposed

that there are two card rooms, but only one picker room, and that in each card room an account is kept of the spindles on each size of roving. It also shows the amount paid in the card room for labor on the stock in process over and above what was in process six months ago. The amount in itself is not of much importance in the card room, but in following this system it is of great importance in subsequent operations, as the amount of some particular class of work may greatly change, although the average value of stock in process may not be much affected.

The expense of each operation should receive credit for all work done on stock on hand in excess of six months previous and an extra charge should be made for labor if the stock in process has decreased.

The data in this sheet are of use later in making of sheets like Table M.

Tables similar to this are made up for each department of the mill.

In the spinning and spooling room we will meet almost the identical conditions as among the roving frames, and may determine the cost after the same methods.

In the warp room we are able to go one step further toward accurate division, in that we may commonly assign directly to each mark of goods, the cost of the machine tender's wages.

Each warp tender is provided on Monday with the following ticket, and it is understood that her wages are made up from it, so that there is small chance for any omission, and any work done by the day must also appear on the ticket in order to receive credit on the time book.

WARPING ROOM. ..... (Employee's name.) ..... Week ending .....

Mark.	Patt.	No. Yarn.	Ends.	Yards or Wraps.	Pounds.	Time.	Rate.	Amt.	Check.		

These tickets are returned to the office with the pay-roll, and the charges for warping each mark of goods, are posted into a book kept for the purpose.

The wages of other hands are separated into various classes as

Tying hands,
Section and beam truckers,

The wages of tying over hands are divided according to the pounds of each kind of yarn done, on the principle that it costs the same to tie a full spool of, say, a pound weight, whether filled with 20 or 50 yarn.

The wages of other helpers, as truck hands and section hands, are divided according to the proportion of wages of warpers.

The labor of beaming and chain quilling for colored work is treated in the same way, on blanks ruled in almost the same form.

In dressing and web drawing the same principle is applied in blanks ruled as follows,

DRESSING ROOM, ...(Employee's name.)..... Week ending .....

Mark.	No. Yarn.	Ends.	Yards.	Pounds	Hours.		Amt.	Check.	

TWISTING, / WEB DRAWING, } (Employee's Name.) ..... WEEK ENDING .....

Mark	Patt.	Ends.	Cuts.	H'rness	BEAMS. M	T	W	T	F	S	Hours.	Rate.	Amt.	Check

The remaining pay-roll is classified and then divided as follows:

Overseeing,	Divide same ratio as total slashers and webdrawers.
Slasher helpers,	" " " " " " " "
Sweeper and scrub,	" " " " " " " "
Truckmen, Sizemaker, Snarler,	" " " " pounds done.

The cost of weaving is always one of the easiest to determine. Looms are limited in their adaptability to different sorts of goods, and though one weaver may tend looms holding warps of various marks there is usually a different price per cut for each. The number of cuts of each kind of cloth multiplied by the price per cut, with the addition of any day work in weaving gives the total cost. To this must be added the expense of

Section hands,	divided in proportion of looms operated.
Filling carriers,	" " " " pounds produced.
Inspecting,	" " " " yards produced.
Room girls, Sweepers, etc., Overseeing,	" " " " total or other weaving costs.

Of course any of these expenses may be assigned to any mark of goods, if by reason of peculiar circumstances it can be defin-

itely placed, but the above seems the most reasonable rule, ordinarily.

The division of the labor of finishing is very difficult, as many of the employees in this department spend their time handling a variety of goods, or working by turns at different tasks. There were, also, many minor operations, involving slight expense, so that the labor necessary to subdivide the labor seems trivial.

In the mill which we are studying the finishing department has the conduct of the following operations.

Trimming, brushing and measuring,	divided per	yards passed.
Sewing,	"	" pieces woven and sewn.
Tentering,	"	" yards goods receiving hard finish.
Calendering,	"	" yards goods receiving hard finish.
Folding,	"	" yards goods passed.
Inspecting,	"	" " " "
Winding,	"	" " " "
Backing,	"	" pieces woven.
Pressing,	"	" " pressed.
Banding,	"	" " banded.
Napping,	"	$\left(\frac{\text{Yards napped} \times \text{runs}}{\text{Widths run at one time.}}\right)$
Binding,	divided per	blankets bound.
Packing,	"	" cases packed.

Sample card making, charged to kind of cards made.

In the dye house a special report is prepared by the overseer, stating how much labor has been bestowed upon each kind of work. This report is appended to the pay-roll and is necessary because the small amount of work and its irregularity, render it inexpedient to keep the same men upon one job.

In a small room this account is easily kept on a card like the following. (Shown on next page.)

Some mills even carry the division so far as to specify the color engaged on when dyeing, and are thus enabled to know the labor cost of each shade.

DYE HOUSE REPORT.

Work done in Dye House.....*Week ending*.....

B = Boiling. S = Splitting. X = Extracting. R = Stock Dyeing.
Ch. = Chain Dyeing. Sk = Skein Dyeing. D = Drying.

NAME.	M.		T.		W.		T.		F.		S.		Total Hours.	Rate.	Total Amount.	REMARKS.
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.				
John Smith,	B	B	B	B	B	B	B	B	B	B	Ch.	Ch.	60	$1.15	$6.90	
Charles Myers,	Ch.	Ch.	Ch.	Ch.	Ch.	Sk.	Sk.	Sk.	Sk.	Sk.	Sk.		55	1.50	8.25	
T. Wright,	X	X	X	D	D	D	D	D	R	R	X	X	60	1.30	7.80	
&c.,																

Having disposed of the cost of stock and labor of manufacture, there remains the third division of outlay, commonly known as

THE GENERAL EXPENSE.

Out of the list of accounts, usually kept, we may select three or four, which may be analyzed by reference to the books, or which may be divided on a reasonable basis.

Of the latter are,

SIZING MATERIALS. These may be divided according to the pounds of warp dressed (which would exclude ply yarns).

DYESTUFFS, which may be divided according to the pounds colored, or a schedule may be made up of the cost of each color, and used as a guide to divide the cost of material.

FINISHING AND PACKING MATERIALS. These are best disposed of by examining the charges to the account, and laying upon each kind of goods the cost of the cases, bands, cards, tape, burlaps, rope, paper, &c., by the best knowledge available of the amount used.

FREIGHT ON GOODS should be separated, and the amount prepaid and freight allowances charged to the class of goods, incurred. The same is true of storage charges.

The most important of the general expenses are thus left untouched. They usually comprise the following expenses, which are kept separate to varying degrees in different offices:

Fuel for steam, for power, heat, dyeing, and drying on dry cans, slashers, and finishing machinery,
Water power,
Oil,
Supplies,
Belting,
Moistening apparatus,
Watchmen,
Stable and yard work,
Lighting by gas or electricity,
Salaries and office expenses,
Taxes,
Insurance,
Repairs on machinery,
Repairs on mill building.
Furniture and tools,
Machinery,
Depreciation,
Interest,
Expenses unclassified.

In making up table H, only a part of which is here shown,—including a part of the card room machinery—a list of the machines in operation is first made. Idle machinery is not included. The machinery is listed at its first cost, including shafting. The amounts in this part of the table are used to determine the proportion of the cost of maintenance to be charged to each department. As this is charged by proportion, it is immaterial whether we take the machinery at half it's value, consider it on the average half worn out, or take it at it's full first cost. The latter plan is followed because simpler.

This equalizes the cost of insurance, taxes, and watch, so that they are not thrown with undue weight upon new machinery. It also enables us to distribute the loss through depreciation. In most mills this is met by charging to running expenses a partial or full amount of the cost of new machinery, and not by a systematic reduction of the machinery on the inventory. The former method is more elastic and convenient, as affording an

It will be noticed that card room machinery is twice listed in the tables H and K, which is to represent the two different rooms in the plant under consideration.

Having obtained the total maintenance and power charges for each department, they may be transferred so far as they apply to sheets like table M, which represent a form used for assembling the costs of manufacture. One of these blanks is used for each kind of goods, on which it is wished to obtain the cost. And when the cost of all the varieties is found, the sum of all should equal the total expense for the period. This sheet is for colored flannel check, but there are spaces for expenses not incurred in flannel check, but necessary in the use of the same forms in other goods.

Besides the sources of outlay which we have already considered, there remain administration expenses which include all office expenses, salaries of general executive officers, etc. There are always numerous expenses which are difficult to classify, because they apply to no particular department, or are so small in amount as not to call for a separate account. For instance, teaming and yard work after having been charged to departments, as far as practicable, leaves a balance which it is impossible to classify.

These may now be added to the cost of labor and maintenance in the same percentage as the sum of all such expenses bears to all labor and maintenance, etc. So far as we may discover any principle applying to the division of these expenses, they should be borne by each mark of goods, in inverse proportion to the production. If one grade of goods can be woven, or one number of yarn spun much more rapidly than another, it should bear a proportionately lesser rate of the general expenses per pound.

In a mill producing goods under such diverse conditions, it is impossible to take either the loom or the spindle as the basis of production, as some cloths are made of purchased yarn and other very different yarns are sold and not woven. But this exact result is yet more equitably accomplished in the manner

stated, for not only is the production of the loom a factor, but the production of the spindle also.

It will be noticed that these expenses are added *before* the inclusion of the cost of material.

The cost of stock is next entered in the spaces provided, and we have obtained the total manufacturing cost.

It is sometimes the case that in one class of goods there will be various styles or patterns differing in organization.

For instance; there might be a line of blankets made of the same yarns, woven on the same looms and yet of various picks, widths, lengths and weights. Or there might be goods having gauze leno and corded effects with different figures and ply yarns.

These may be classed together as one grade of goods in some of the stages of cost finding but a separate account may be kept of the operations of warping, weaving or wherever else desired.

A separate assembling sheet [M] may be made for each style or pattern if desired with only such changes from the others of its grade as may be demanded by its different particulars.

There yet remain interest, profit and commissions. The first is added as a percentage of the manufacturing cost.

It is of course understood, that profit is a matter governed entirely by circumstances, and one which cannot be regulated at will nor by any arbitrary rule. Nevertheless, so long as business is carried on for profit and not for pleasure, so long dividend accounts may be legitimately included as a portion of the cost of manufacture. Attention is called to the fact that *the percentage to be added for a reasonable dividend should be based not on the full cost of the goods, but on the cost of labor and maintenance*, as shown in line 47. A percentage of the selling price, which might seem reasonable, might also be higher or lower than necessary for fair profit, according to the production possible on that same kind of goods. Of two marks of goods which have the same cost to the mill, a profit of 5 per cent of the selling price on one, might yield as much as 10 per cent on the other, if the character were such that the same ma-

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chinery could produce double the amount. The fact is more fully illustrated, where the two objects of manufacture are entirely dissimilar. It was stated some years ago by the Commissioner of Labor of Massachusetts, that a profit of 4⅓ per cent. on the selling price of boots or shoes would be equivalent to 14 per cent. on the capital invested, while gas and residual products show a profit of 21 per cent. of the selling price, but less than 8 per cent. on capital invested.

The last item to be added is the commission for selling goods.

In reviewing this method, the first impression, will doubtless be that it entails a great amount of labor, but this is always the case where so much detail is necessary, and there seems to be reason for the belief that the labor, after this plan is no greater than in others giving equally certain results. In fact a large portion of the work may be done before the accounts are closed.

As remarked in the beginning, the data used in this method of finding costs, are largely required for other purposes, and if care be taken to formulate them aright, they may be found ready to hand. Carefully followed out aud intelligently used this method will give the most accurate results of any yet described. In some ways it involves no more work, perhaps not as much as Method III where there is a considerable number of grades of goods; but the labor is thrown more upon the head office and less upon departments. It is therefore well suited to those mills which employ a cost clerk for the purpose of making estimates of past and prospective products.

The department of cost determination has long been regarded as of prime importance in numerous mechanical industries, and those cotton mills making a variety of products are recognizing the necessity of careful work in order to obtain results which may stand stand examination. It is seldom, however, that a clerk has the requisite information, experience and judgment to arrange a proper method. The work of laying out a system devolves upon the practical manager. It is hoped that these descriptions may be of use to some upon whom this duty falls,

and of interest and information to many more who have a desire to know how such work is done, even though they may not at present have need to apply their knowledge.

The PRESIDENT. We will now listen to a paper [illegible]e Application of Mechanical Draft to Stationary Bo[illegible] Mr. WALTER B. SNOW, Boston, Mass.

THE APPLICATION OF MECHANICAL DRAFT TO STATIONARY BOILERS.

WALTER B. SNOW, Boston, Mass.

eration of mechanical draft, comparison must
between the chimney and the fan blower as a
oduction. Inasmuch as the steam jet usually
peration from five to ten times as much steam
his method of producing draft does not properly
sion.

, because of its method of operation, is of neces-
ingly inefficient device for moving air, for a rela-
nperature of the flue gases is absolutely essential
As a result, from 20 to 40 per cent. of the heat of
ted in the atmosphere without further useful
by far the greatest waste occuring in modern
Any attempt to utilize a portion of this waste
y reduces the temperature and lessens the draft,
case of a chimney, can only be made good by in-
height. A chimney 100 feet high with external air
s and internal gases at 500 degrees will produce an
pressure of about 0.65 of an inch. If the tempera-
gases be lowered to 300 degrees a chimney about
height will be required to produce the same intensity,
a temperature as low as 200 degrees the chimney will
be about 240 feet high.

The low chimney effective utilization of the heat of the
ases is therefore impossible, for in order to maintain the

draft they must of necessity pass away at relatively high temperature. A high chimney on the other hand entails considerable expense and even then continues to wastefully employ the heat.

As compared with this wasteful process of air movement a fan calls for an expenditure of only about $\frac{1}{15}$ of the heat required by the ordinary chimney to produce the same results. Or in other words practically all of the heat of the waste gases is rendered available for utilization and it only remains to provide the necessary means for abstracting the heat. For effective working the initial temperature of these gases must be approximately 75 degrees above the temperature of the steam within the boiler. Between this point and the atmospheric temperature is marked the range through which the heat abstractor may be effective.

The fuel economizer is now well established as an effective means of transferring the heat from the gases to the water fed to the boiler. It naturally shows the highest efficiency when the initial temperature of the gases is excessive, that of the water entering the economizer is low and the fuel is high priced. The temperature of the gases necessary to produce the requisite draft with a chimney, evidently marks the limit to which they may be cooled by the economizer. With a fan, however, the intensity of the draft is practically independent of the temperature of the gases, and in point of fact when a fan is applied upon the induced principle, a decrease in the temperature actually increases the intensity of the draft produced at a given speed. It is here therefore that the fan shows its fundamental advantage over the chimney, in that it renders available for utilization practically all of the waste heat.

Reports of tests made by Mr. WILLIAM R. RONEY in plants equipped with fuel economizers and mechanical draft apparatus in place of a chimney show an average saving of about 15 per cent. resulting from the introduction of this combination.

Another means of utilizing the heat of the flue gases is by air heaters or heat abstractors. In 1881-82 Mr. JOHN C.

HOADLEY carried on at the Pacific Mills, Lawrence, Mass., an exhaustive series of tests of the Marland apparatus so arranged above the boiler that the gases drawn therefrom by means of a blower served to heat the incoming air before it entered the ash pit. The result was an increase of about 300 degrees in the temperature of the air so admitted and an opportunity for perfect control over its volume and pressure independently of atmospheric conditions.

A maximum boiler efficiency of nearly 90 per cent. was thus secured while the steam required to drive the blower with a reasonably good engine was stated to be only one per cent. of that generated by its use. Although certain features of this particular apparatus militated against its general use other devices such as those applied to marine boilers by Ellis & Eaves and by HOWDEN have shown satisfactory economical results.

Evidently there are limits to such attempts at saving, for they can hardly be seriously considered in small plants, but the field is invitingly open for further economical advancement along these lines.

In the primary introduction of mechanical draft as a substitute for the chimney, first consideration is of course to be given to the relative costs of the two devices and to the expense of their maintenance and operation. From comparison of a considerable number of plants differing widely in character and capacity it appears that under ordinary conditions:

A single forced-draft fan with direct-connected engine and short stack can be installed for less than 20 per cent. of the cost of a brick chimney;

A single induced-draft fan with direct-connected engine and short stack will cost less than 30 per cent. of a chimney; and that

A duplex induced-draft apparatus consisting of two fans with direct-connected engines, inlet and outlet connections and short stack will cost but little more than 40 per cent. of a chimney. The latter arrangement is only employed where, as in the case

of an electric lighting plant, it is the practice to introduce relay units.

Of course the height of the delivery stack must depend upon the elevation of the surrounding buildings. Where tall buildings are not adjacent and the boiler house is of moderate height, the smoke pipe need pass only just above the roof. This is in fact the customary practice. But where the smoke must be discharged near to other buildings, it is obvious that the delivery pipe must be carried above their roof line. Owing however to the positive action of such a fan, the area of the stack may be materially less than would be required with natural draft.

The cost for maintaining a mechanical draft apparatus depends to a certain extent upon the method of application. If applied to force air to the ash pits it will operate at moderate speed, will handle only cool air and will certainly have as long a life of service as the usual boiler fixtures and attachments. If employed to exhaust the gases from the boilers, it will be subjected to temperatures ranging up to perhaps 600 degrees. Disregarding leakage the capacity will have to be greater in proportion to the increased temperature and decreased density of the gases, and the circumferential speed will have to be higher to produce the same intensity of draft. Within the ordinary range of temperatures the constituent gases, which are of necessity dry, have no deleterious effect upon the steel plate of which the fan is constructed. Overheating of shaft bearings is avoided by passing water through chambers provided in the boxes. The conditions, so far as they affect the life of the fan, are therefore practically no more adverse than in the case of a forced-draft installation. As evidencing the durability of a fan operated under these conditions it may be stated that in 1892 Cheney Bros., of South Manchester, Conn., installed in connection with a plant of 1000 horse power, an induced-draft fan for taking care of additional boilers and economizers; the chimney being of insufficient capacity to do the work. A recent report indicates that this fan shows no effects of wear and that there is no evidence but that it will last for a long time.

The expense of operation depends of course upon the disposition of the exhaust from the fan engine. If this is utilized as it should be in any well planned plant the cost of draft production becomes almost infinitesimal. If, however, the exhaust must be discharged to the atmosphere the actual expense for operation, as measured by the proportion of steam so used, compared with that generated, ranges from one-half to two per cent. in plants of reasonable size up to perhaps three or four per cent. in small plants. It may be readily shown that with the smaller amount the annual fuel expense for operating the fan will be materially less than the fixed charges on the additional cost of a brick chimney to produce the same results. Any great expenditure for operation is almost universally offset by increased efficiency of combustion and decreased cost of fuel.

It is evident that mechanical draft may be introduced either as a substitute for, or as an auxiliary to, a chimney and furthermore that it may be installed for operation on either the forced or the induced principle as may be desired.

Conditions are so effective in determining the choice that it cannot be assumed that either method of application is distinctly superior to the other. The accompaning illustrations will best serve to show the manner of application in specific cases and to a certain extent the conditions which controlled in the determination of the method to be employed.

One of the simplest methods of installing a forced-draft system in an existing boiler plant is illustrated in Fig. 1. The fan which is of steel plate with direct-connected double-cylinder engine, is placed immediately over the end of a brick duct into which the air is discharged. This duct is carried under ground across the front of the boilers, to the ash pits of each of which connection is made through branch ducts. Each branch duct opening is provided with special ashpit-damper, operated by notched handle bar, as illustrated in the detail. This method of introduction serves to distribute the air within the ashpit and to secure even flow through the fuel upon the grate above. Of course the ashpit doors must remain closed in order to bring about this

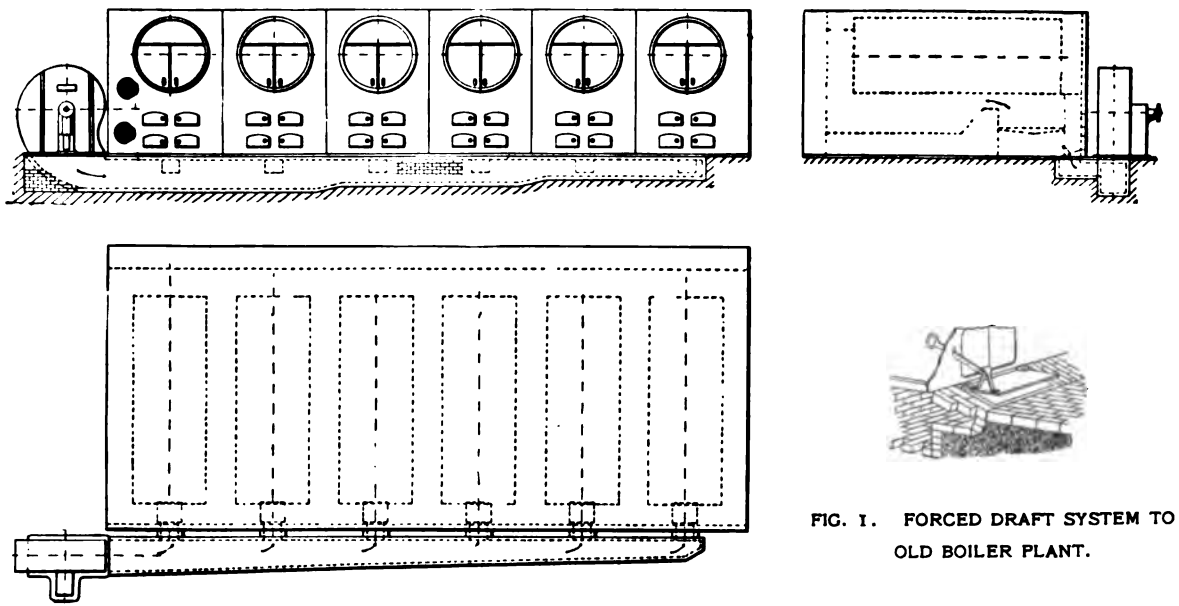
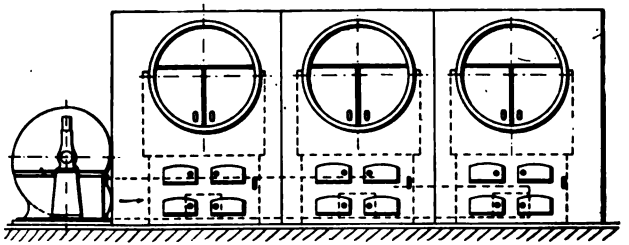
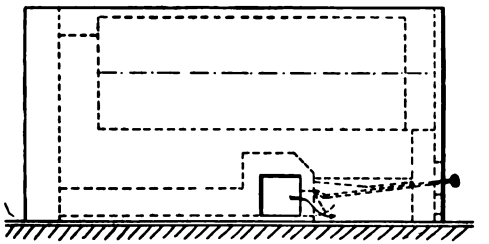
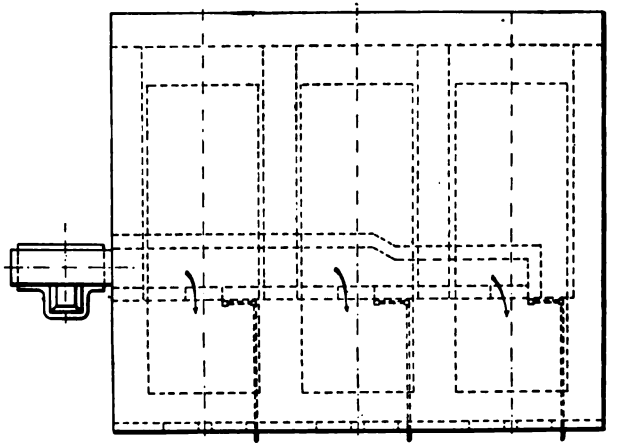


FIG. 1. FORCED DRAFT SYSTEM TO OLD BOILER PLANT.







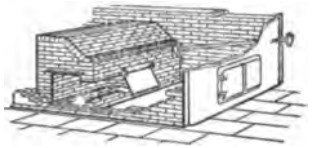


FIG. 2. FORCED DRAFT SYSTEM TO NEW BOILER PLANT.

result. A chimney of sufficient height to merely discharge the gases above objectionable level is all that is absolutely necessary with this arrangement. Although the introduction of a fan in an old plant is usually evidence of the insufficiency of the existing chimney to meet the requirements, such a chimney will, however, usually serve as a discharge pipe for the gases when the fan is employed. The fan thus becomes more than a mere auxiliary to the chimney; it practically supplants it so far as the method of draft production is concerned.

In the equipment of a new boiler plant with a forced-draft system it is frequently desirable to construct a hollow bridge wall as shown in Fig. 2, and to discharge the air from the fan through the duct thus formed and thence to the ashpit through the damper as shown in the detail. The fan may be of regular construction and set close up to the side of the boiler setting as indicated. The chimney need extend only above the boiler-house roof unless the immediately adjacent buildings are of greater height.

In the installation of an induced-draft system in a new plant a most convenient arrangement is that presented by the Cora Mfg. Co., as shown in Fig. 3, where the fan is supported above the boilers and connected directly with the main flue from which the gases are drawn.

A high speed double-cylinder engine with water-cooled bearings carries the fan wheel upon its extended shaft. The engine is entirely closed, provided with continuous oiling devices and capable of sustained operation. From the fan the gases are discharged upward to the atmosphere through a small pipe extending just above the roof. Of course a very similar arrangement may be adopted in an old plant by connecting to the main flue and preventing the passage of the gases to the existing chimney, or the gases may be by-passed through the fan and delivered with increased velocity to the chimney which merely serves as a means of carrying them up to a suitable level.

A somewhat different method of installation in a comparatively small plant is presented by the Patterson Textile Co., shown in

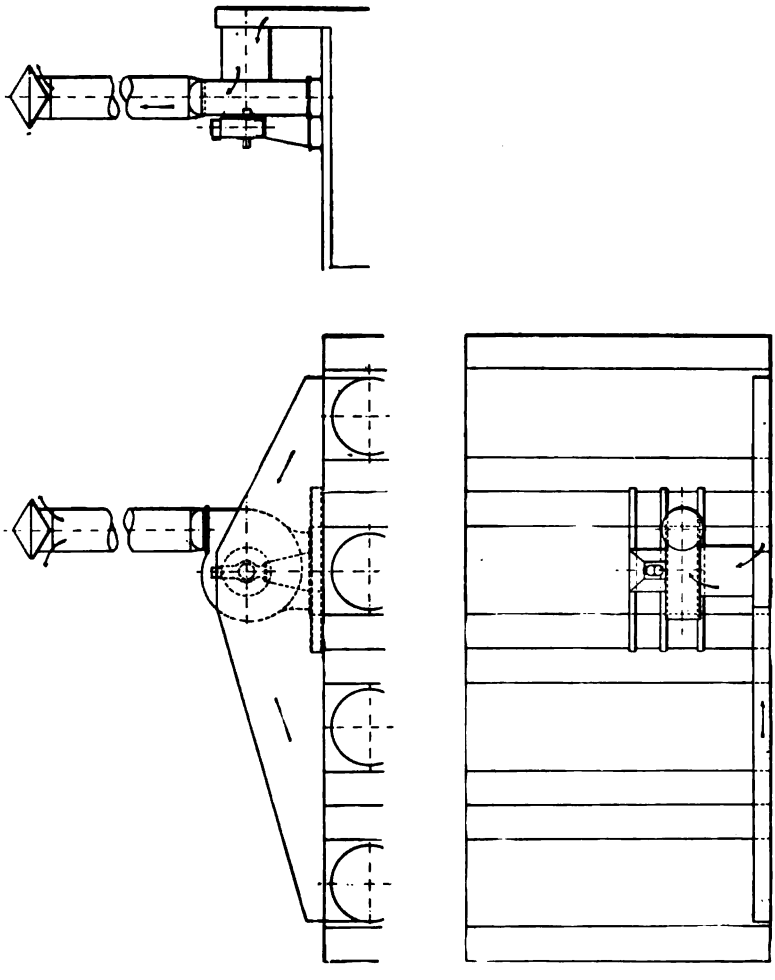


FIG. 3. CORA MANUFACTURING CO., HAW RIVER, N. C.

Fig. 4, where the circular flue connects directly with the inlet of the fan which is partially supported and partially suspended above head level, and discharges the gases directly upwards. In neither this case nor the preceeding is any valuable floor space occupied.

It has already been pointed out that a forced-draft fan may

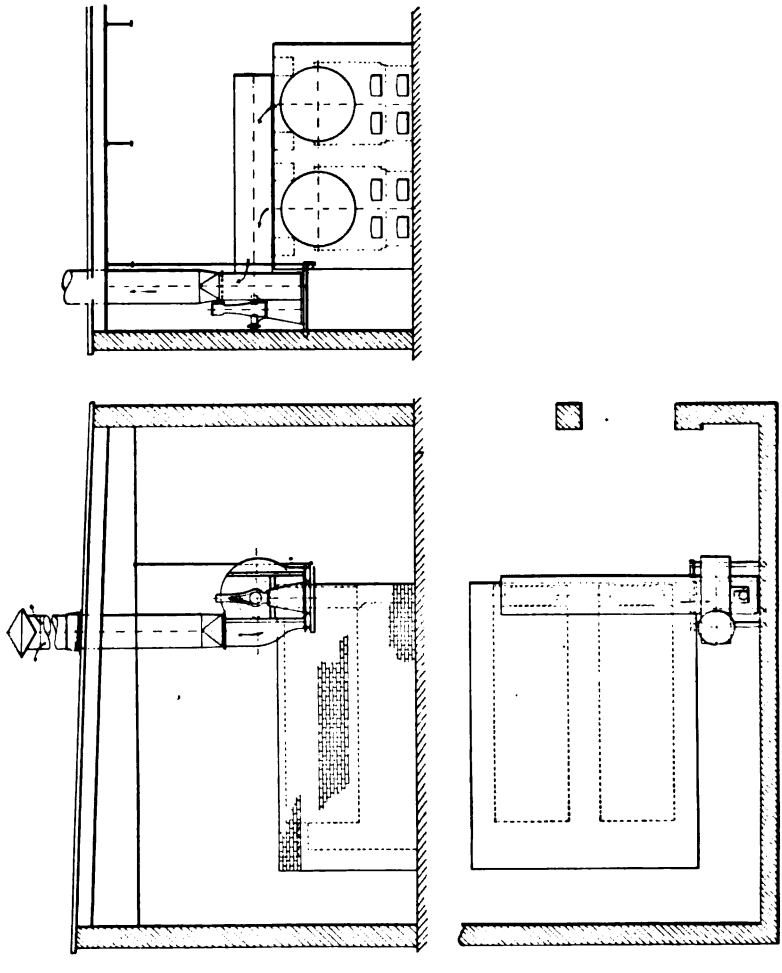


FIG. 4. PATTERSON TEXTILE CO., ROANOKE RAPIDS, N. C.

be readily installed to make good the insufficiency of an existing chimney. In a similar manner an induced-draft fan may be applied to perform the work of a chimney which has proved itself inadaquate. An excellent example is presented by the Wampanoag Mills in Fig. 5. The original course of the gases was through the under ground flues AA into the base of the

chimney. Under this arrangement the draft was produced for about 1200 boiler horse power.

The battery having been increased to about 2000 horse power a fan was installed instead of building another chimney, which would otherwise have been necessary, while the existing chimney was used merely as a discharge pipe from the fan. When in operation the fan draws the gases through the branch duct B into the chamber C whence they pass to the fan and under its positive action are discharged through D to the chimney. A damper E serves, when closed, to prevent passage of gases to the chimney through the old duct AA. Under this condition the old chimney with damper E wide open meets the requirements for steam raising before the mill is started, but during working hours the fan is necessary to maintain the required output. Under the circumstances it is therefore perfectly feasible to drive the fan by belt and operate it only during these hours.

Wherever the fan is the sole reliance for draft production it is of course necessary that it should be provided with an independent engine, usually direct-connected, so that it may be operated as soon as steam is raised in the boiler. The height of even a small stack is sufficient to start the fire, while the fan begins to operate as soon as a few pounds pressure is attained. Inasmuch as the power necessary to drive a fan varies as the cube of the speed, it is evident the power required per revolution at $\frac{1}{4}$ speed is only $\frac{1}{16}$ of that required at full speed while with $\frac{1}{4}$ of the power per revolution the fan may be run at $\frac{1}{2}$ speed. There is therefore no difficulty in raising steam without a chimney if the independent engine is provided.

The installation of an economizer frequently introduces such resistances that a chimney capable of producing the draft without the economizer becomes insufficient when the gases are lowered in temperature and the increased resistances are introduced. Such was the case at the Talbot Mills. In order to utilize the economizer and the existing flue connection, and at the same time meet the requirements of an increased boiler plant an induced-draft fan was installed as illustrated in Fig. 6.

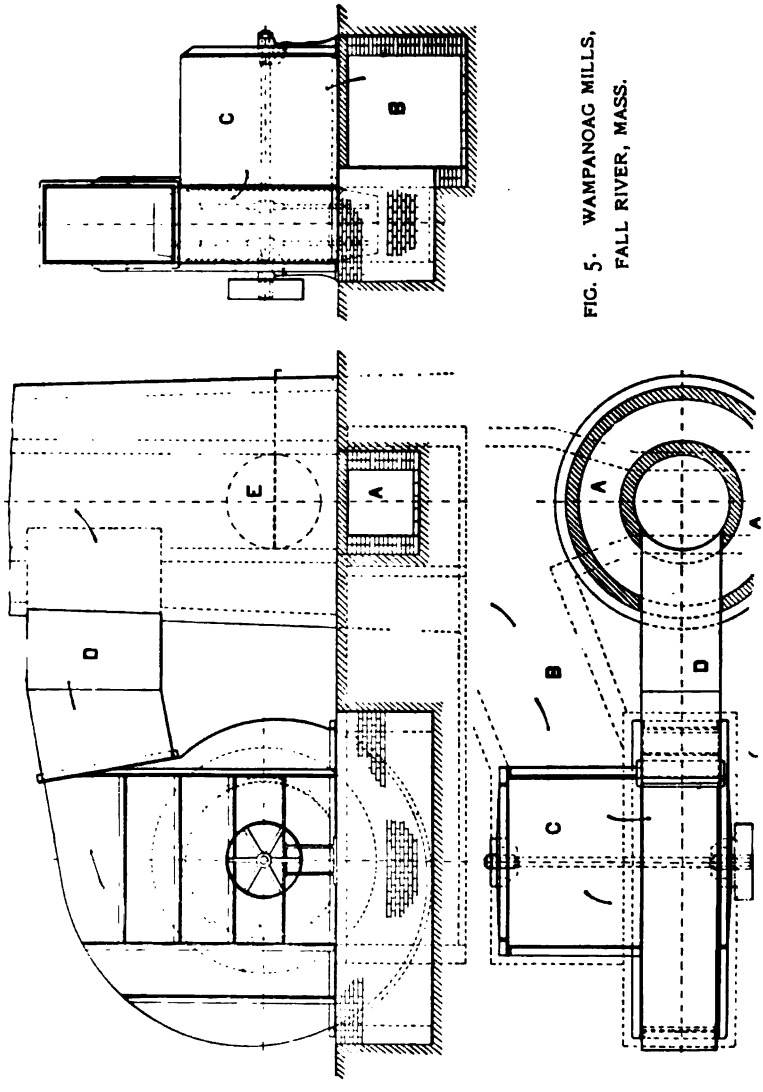


FIG. 5. WAMPANOAG MILLS, FALL RIVER, MASS.

Before the fan was introduced the gases passed with considerable difficulty from left to right through the flue A and thence downward and through a fuel economizer situated to the right of B, but not shown. From this they passed through the opening D to the discharge flue H. When the economizer was thrown out of service the damper G was swung over to the right and the gases passed from A on the left directly to the discharge flue

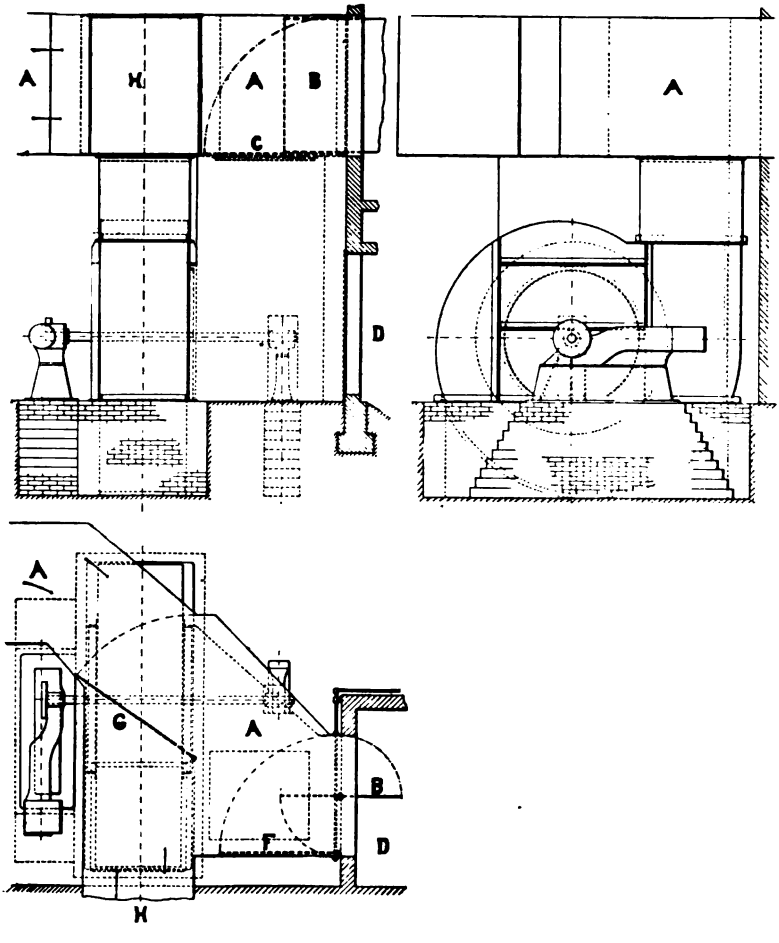


FIG. 6. TALBOT MILLS, NORTH BILLERICA, MASS.

H. The introduction of the fan made possible the continuous action of the economizer with increased efficiency, and the operation of a larger number of boilers and also made it feasible to secure combinations as follows. The gases may pass as before from A through the economizer and the opening D, whence they may enter the fan, which creates the necessary intensity of draft to overcome the resistances, and discharges the gases directly upward into the flue H. In case the economizer is thrown out of service the butterfly damper B can be closed, the swing damper C raised so as to leave clear the opening beneath it and the gases allowed to pass directly downward into the chamber below, thence through the fan up into flue H; or the fan may be stopped and the gases may pass through economizer, opening D, and through the fan to the flue H, but of course with much decreased intensity of draft; or when they pass directly from A to H, the damper G having been properly adjusted. Had the fan not been installed neither the economizer nor the extra boilers could have been successfully operated with the existing chimney, and to secure their proper efficiency a new chimney would have been required.

In this instance the fan is driven by a direct-connected horizontal engine with the shaft extending through the fan and a portion of the chamber, at the outside of which it is supported in a water cooled box.

An interesting comparison between a chimney and an induced-draft fan standing side by side, is presented in Fig. 7 which shows the arrangement at the Arlington Mills. The chimney serves an old battery of boilers while the fan produces draft for a new battery of nearly 100 per cent. greater capacity. It will be noted that the area of the fan outlet is less than that of the chimney, notwithstanding that it serves nearly double the boiler horse power. The fan wheel is overhung within the casing, the shaft being supported by external bearings. The gases passing through the inlet A are discharged through the pipe B which extends only a short distance above the roof. The fan is

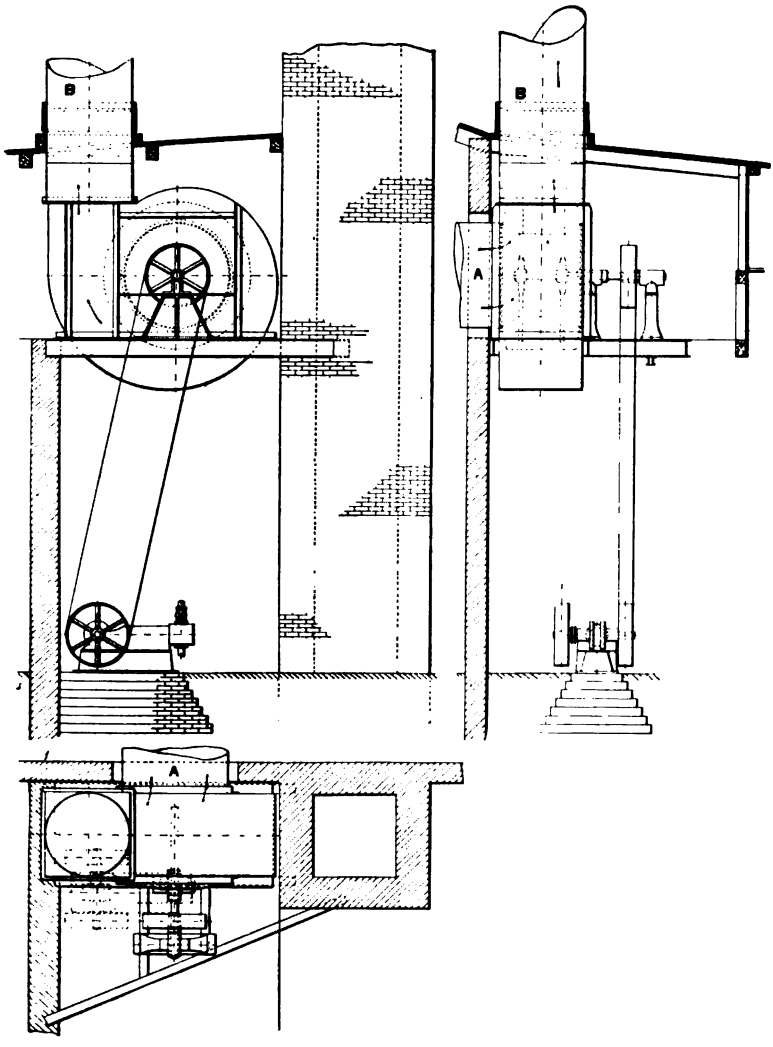


FIG. 7. ARLINGTON MILLS, LAWRENCE, MASS.

driven by belt from a horizontal engine which is placed below. Otherwise than this no valuable floor space is occupied.

The equipment of an entirely new boiler plant with a complete system of mechanical draft is well illustrated in the case

of the Warren Mfg. Co. At present five Corliss boilers of 1250 horse power are installed in connection with the flue A which conducts the gases to the chamber, within which swing the dampers C and D, and which connects with the inlet of the fan E. When the entire plant is complete five more boilers will be installed to discharge into flue B and thence into the receiving chamber between the fans E and F. The dampers C and D are so arranged that the gases may be permitted to pass through either, both or neither of the fans as desired. In the latter case

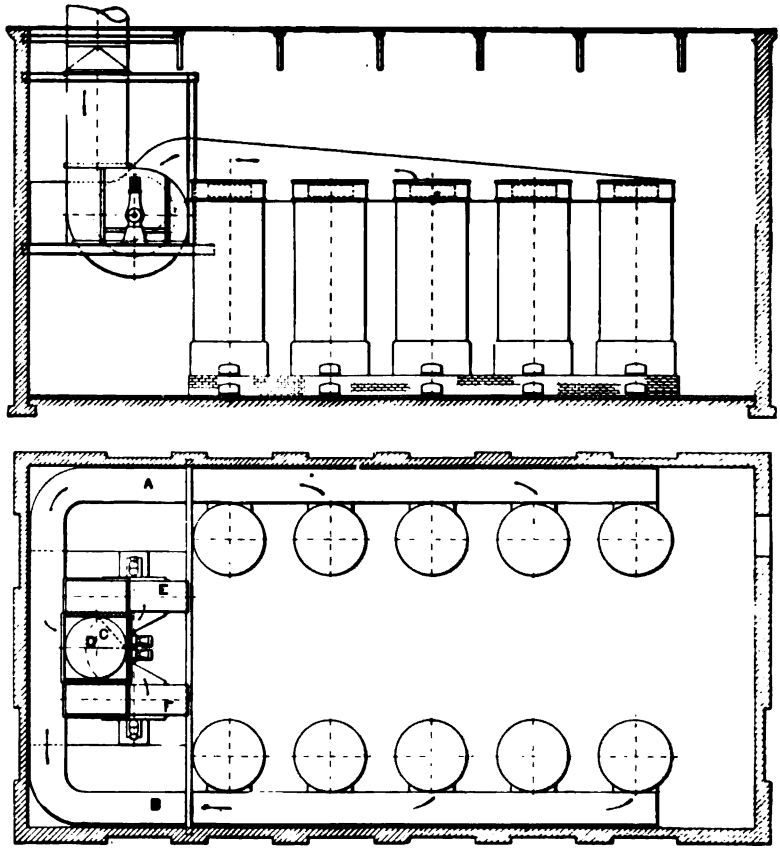


FIG. 8. WARREN MANUFACTURING CO., WARREN, S. C.

they may be discharged directly to the stack above. Each fan wheel is eight feet in diameter by three feet in width and driven by a seven-inch by five-inch double engine entirely enclosed, provided with water-cooled bearings and designed for continuous operation without special attention. The combined capacity of the fans is considerably in excess of the rating of the entire plant so that either fan may serve as a relay and permit of cleaning and repairing the other if necessary. The entire apparatus is supported above head level and the stack extends only ten feet above the four-story mill which is adjacent. No other means of draft production is provided.

All types of engine-driven fans such as have been presented in these illustrations can be readily controlled by the steam pressure through the medium of a special regulating valve, or a combination of damper regulator and lever valve. A very slight rise or fall in the steam pressure actuates the valve and greatly decreases or increases the amount of steam admitted to the engine. The steam pressure can thus be automatically maintained within a pound above or below the normal while the fan instantly responds to changes in conditions and particularly to sudden demands for more steam. This feature of flexibility and of ready response is almost invaluable in plants where there are great fluctuations in the steam requirements, such for instance as in dye houses and bleacheries. Higher fan speed not only increases the air volume but coincidently increases the intensity of the draft which of course facilitates the ready passage of larger volumes at higher velocity.

Surplus capacity can be more readily and economically provided in the fan than in the boiler. That is to say, within limits it costs far less to install a fan of sufficient capacity to force 1000 horse power of boilers to an output of 2000 horse power to meet sudden or temporary demands than it does to provide a like surplus in boiler capacity. The fan thus finds special opportunities for service in connection with mills which are usually operated by water power but which of necessity must install steam plants to meet possible contingencies of low water. In-

asmuch as such a plant is likely to be operated for only a portion of the year it is warrantable to force it and thus operate it under somewhat less economical conditions than could be obtained if a much more expensive equipment was installed to secure a higher efficiency.

In the case of sudden accident like the destruction of a chimney, the fan, which can be built and shipped on short notice, may perform even a temporary service of great value during the erection of a new chimney. Experience with the fan is however likely to result in doing away with a chimney altogether.

The largest item of operating expense being the fuel, it is natural that in a boiler plant special attention should be given to the reduction of this item. It is manifest that low grade fuels are almost invariably more finely divided and require greater draft pressure than those of better quality. With the customary height of chimney, ranging from say 100 to 150 feet and particularly with economizers it is difficult to produce sufficient intensity of draft to burn fuel of this character. For the burning of No. 2 or 3 buckwheat coal at a very moderate rate of combustion, that is less than 15 pounds per square foot of grate, a draft of five-eighths inch to more than one inch of water is required. The theoretical height of a chimney to produce the latter intensity with external air at 60 degrees and gases leaving an economizer at say 350 degrees is very nearly 200 feet. The fan, introduced either for forced or induced draft, readily creates this intensity while operating at moderate speed. This speed may be automatically regulated to the exact requirements of the fuel.

Inasmuch as the average height of chimney practically determines the relation between the rate of combustion and the quality of the fuel which may be burned, it indirectly establishes the proportions of the boiler. An increased rate of combustion necessitates a deeper fire and more intense draft which the chimney may be unable to produce but which may be readily created by means of a fan. Each particle of air in passing upward through the deeper bed of fuel, under this more intense draft, thus has better opportunity for parting with its oxygen

and therefore produces more effective combustion. Principally for this reason plants operated by mechanical draft have been forced far beyond the boiler rating without showing material loss of efficiency.

As this system of draft production becomes more generally introduced we may therefore look to certain changes in boiler design which will more effectively meet the conditions of high furnace temperatures with decreased air supply. The economy in fuel resulting from the introduction of mechanical draft is of necessity relative for it depends largely upon the quality of fuel which it was possible to burn before this method was installed. Thus, for instance, in the 1000 horse power boiler plant of the United States Cotton Co., at Central Falls, R. I., it was necessary to burn Cumberland coal costing $4.00 per ton when chimney draft was used. The introduction of a forced-draft system costing less than $600.00 made possible the reduction in quality and price of fuel to a mixture of about 70 to 75 per cent. of No. 2 buckwheat, 20 to 25 per cent. of yard screenings and 5 to 10 per cent. of Cumberland, costing $2.62 per ton. The result in annual saving was about $6500.00. Of course such comparisons are largely affected by geographical location and the possibility of securing low grade fuel. But it is evident that mechanical draft may be employed to burn almost any grade that it is practicable to employ.

Mechanical draft has thus been shown to cost far less for installation than the chimney, to be essential to the most complete utilization of the waste heat of the flue gases, to be capable of burning low grade fuels and decreasing the fuel cost, be able to readily meet sudden and excessive demands for more steam, to be flexible in its character, entirely independent of atmospheric changes, and capable of adaptation to almost all conditions whether as a substitute for, or an auxiliary to a chimney. It is manifest that it may be installed either on the forced or induced principle as required, and that it may be automatically controlled so as to maintain constant steam pressure. The recent remarkable increase in the adoption of this method of draft

production is far better evidence than any personal prophecy of the fact that mechanical draft will occupy a most important position in the boiler plant of the future.

The PRESIDENT. The next paper is upon a similar subject The Height and Area Required for Chimney Draft by Mr. H. G. BRINCKERHOFF, Boston, Mass.

THE HEIGHT AND AREA REQUIRED FOR CHIMNEY DRAFT.

H. G. Brinckerhoff, Boston, Mass.

There is no more perplexing problem to the designer of the steam plant than determining what should be the proper height and area of the chimney. Text books and pocket manuals lack in solid information. Formulas and recommendations there are indeed, but a reputable engineer while necessarily using many tables prefers to make use of none whose principles he does not thoroughly understand and knows to be based upon correct mathematical and physical laws. The uncertainty of the basis upon which to determine this requirement is doubtless a factor, along with other considerations, in the growing use of artificial draft, by ending all anxiety for a mistake in this most essential feature.

Theoretically there is no need for a particular height for any size of steam plant nor for any amount of horse power. We have only to select any height that pleases us, or strikes our fancy. This fact has been reached by many with the resulting tendency to cut off on chimney length. A mill engineer told me of one of his clients for whom he was designing a stack 175 feet high, and to whom some one had demonstrated that he could get all the draft required at a greatly reduced cost by a height of only 100 feet but with enlarged area. The architect did not bother to glance at the calculations, but told him "Go ahead, build your chimney one foot high and as big as all out doors if you want to, but you need *height* to get *vim*."

It can be ascertained by a process to be given later, what

number of pounds of air, or gas at a stated temperature, would be discharged in a given time from a chimney 100 feet high, and whose area was one square foot. For a plant, then, of ten thousand horse power we have only to ascertain how much gas is to be carried off or better expressed, quantity of air to be furnished the fuel, and increase the area proportionately. But who so bold or so foolish as to attempt such a construction for that amount of power even with the theoretical demonstation of its feasibility, or would hold to that height even if he had allowed 50 or 100 per cent. additional area for contingencies or "leeway."

Why? Well, because while it is true that such a height should give equally as good a draft for a large, as well as a small plant, and if every boiler should directly discharge into the stack instead of into a long horizontal flue, they would all individually obtain a *good* draft, the theoretical takes no account of the distance the gases had to travel to reach the chimney, nor the resistance through a thick bed of coal, and where the farthest furnace may be 100 feet or more away from its base, nor of the friction in the flues and boilers, the most efficient boiler being one whose entire heating surface is brought into direct contact to the heated gases, which means friction.

Here we get at the function of height and appreciate its necessity and importance for obtaining a good combustion in the furthest boilers, enabling them to meet quickly and efficiently the demands for steam at all times and under any circumstances.

The tendency of today is towards large units of machinery. Single engines are being built of 4,000 indicated horse power, direct-connected to huge motors and in the boiler room 1,000 horse power units are not uncommon. A boiler of such capacity requires heavy coaling per square foot of grate and a strong draft pressure to burn it intensely.

We understand the working of the chimney better when we make a distinction between the two elements of its function — its requirement to handle a given *capacity* and to produce a *draft* or *pressure*. Capacity is principally dependent upon chimney area and pressure upon height. Draft pressure as in-

dicated by the water column, is the same for any height and inside temperature, irrespective of area. Thus if two chimneys were each 100 feet high and the temperature inside the same, the draft pressure in inches of water would also be the same, although the area of one was twenty times greater than that of the other.

The understanding that additional height only increases the capacity in the small ratio of the square foot of the height of the one to that of the other, has tended toward shortening that dimension. But height should not be considered for capacity, but should be great enough to obtain sufficient pressure to meet all the conditions of the plant and we do get a *direct proportionate* gain for every foot of added height and twice the height will give double the draft force.

The height should be determined first, and then the area for the capacity can be determined accurately and mathematically, the task of the engineer being to estimate the resistance encountered through the furnaces, boilers, and flues and then calculate what amount of draft pressure the chimney should have to burn properly the coal in the end boiler. Assuming the pressure required, the rule for determining the height is as follows:

Divide 7.6 by the absolute temperature of the external air ($Ta = t$ (temp. of external air) + 460); divide 7.9 by the absolute temperature of the gases in the chimney ($Tc = t'$ (temp.) of internal gases) + 460); then divide the given draft power by the remainder, the result is the height in feet. Or by formula: $h = \dfrac{d}{\frac{7.6}{Ta} - \frac{7.9}{Tc}}$

My suggestion for making use of this formula for height is to take the internal gages to be only 300 degrees, to be on the safe side, and assume arbitrarily a draft pressure of one-tenth required per 100 horse power up to about 400 horse power, or *.4. for 400 horse power;* for each 100 horse power additional one-twentieth, .05 of an inch up to 800 horse power, or *.6 for 800 horse power;* for each additional 100 horse power up to

1600 horse power, one fortieth, .025 of an inch or *.8 for 1600 horse power;* and again for each additional 100 horse power one-eighteenth .0125 up to 3200 horse power, or *one inch for 3200 horse power.* The reason for the proportionate lowering of the intensity with the increase of capacity, being due to the offset of reduced friction through the larger flue passages, and were I to advise further than 3200 horse power would be inclined to add one-tenth of an inch for each additional 1000 horse power up to *1.5 of an inch for 8000 horse power* and one-tenth for every 2000 horse power beyond or *two inches for 18,000 horse power.* But no fixed rule can or should be made for height, as the character of boilers (whether water tube or tubular, upright or horizontal), depth and quality of fuel, the length, smoothness, turns and connections of flues, and local conditions have a most important bearing—as has been previously noticed 100 feet in height *might* be ample for any size of plant.

Having determined the height, the area is readily determined by previous examples. Allow five pounds of coal per Centennial Standard of horse power with 125 pounds of air or gas therefrom, and assume that as much air again is drawn through cracks and the porous brick about the boilers, flues, and chimney, or 250 pounds of gas to be removed per hour per horse power, then allow the customary two inches of circumference for ineffective area.

To save time of referring to previous pages, the process will be briefly re-stated, leaving out of the calculation the heavier specific gravity of the gas the difference being only .03, an inconsequent effect where 100 per cent. surplus is provided to be handled. The height having been ascertained, or assumed.

First step: $Ta : Tc :: H : H'$

Second step: $\sqrt{(H' - H)\ 64.4} \times \frac{H \times .76}{H'} = P$ or the pounds of air or gas per second that will escape from one square foot of area per second from the given height.

Third step: $\frac{Given\ H.\ P. \times 250}{P \times 3600\ seconds} = Area.$

Fourth step: Add to diameter of circle that would enclose the obtained area, four inches or the same number of inches to a side of the square having the above area but perferably five inches to side of square.

We determine the height by the foregoing to be:

95	feet,	or	in	round	numbers	100	feet	for	400	horse	power	.4 inch.
143	"	"	"	"		150	"	"	800	"	"	.6 "
190	"	"	"	"		200	"	"	1600	"	"	.8 "
238	"	"	"	"		250	"	"	3200	"	"	1.0 "
357	"	"	"	"		350	"	"	8000	"	"	1.5 "
476	"	"	"	"		475	"	"	18000	"	"	2. "

The inside diameter then of a round chimney to correspond should approximately be

4′1″	diameter	100	feet	high	400	horse	power.
4′10″	"	150	"	"	800	"	"
6′2″	"	200	"	"	1600	"	"
8′4″	"	250	"	"	3200	"	"
12′3″	"	350	"	"	8000	"	"
16′4″	"	475	"	"	18000	"	"

I wish it to be noticed that my calculations are made on a very low basis of the outside air at 60 degrees and internal gases at 300 degrees. I have seen chimneys, having probably hotter internal temperature, particularly in zero weather, give double the draft pressure for some of the sizes mentioned. Also I believe with careful design of flues and grouping of the boilers, and having two or even four ports, that a chimney 400 feet in height would handle any capacity of plant that would ever be required to be installed into a single power house.

It will be observed that my areas are under the dimensions given in the standard tables for the stated amounts of horse power. There can be no objection in operation from too much height if draft is controlled by an automatic damper, but why so great an area is called for by the authorities, I for one, fail to comprehend. It appears to me that excessive area would be detrimental rather than beneficial, as the space not

being filled by the contents necessary to be discharged, would result in causing down currents from above. I have apparently, it seems to myself, made allowances beyond all ordinary or extraordinary requirements, and submit my conclusions for whatever interest they will have to some.

'To elaborate the purpose of this paper I would call attention to the fact that the only formulas I considered necessary to use in the foregoing were the two simple rules given in every elementary physics for the increase of the volume of gas with increase of temperature, and the velocity for any falling body, and I recommend to the designer that he base his work upon a like calculation using his own judgment as to what allowances to make for friction, increase to volume by leakages, and a margin for greater horse power development for expansion with future growth. It would be a confession of inability to design things too big, as too little, precisely as it is poor engineering to build 24-inch walls when a 12 would answer every purpose, or to use ten-inch pipe where a two-inch would do as well. I advocate less guess work and the use only of the natural laws controlling the operation of chimney. Surely our present calculations for chimneys must be excessive when we find, as at the Atlantic Mills, Providence, R. I., a chimney 110 feet high with the inside flue 46½ inches square, maintaining a satisfactory draft for 16 horizontal tubular boilers developing between 1500 and 1800 horse power. The chimney area is 15 square feet, while the combined area of all the boiler tubes is 62 square feet, or more than four times the former. This case figures that the plant is developing close to the theoretical possibilities of the chimney. The latest authorities recommend a stack of that given height and area adequate for 470 horse power, while here in a case of practical use it is good for four times that amount. It is true that this is a particular instance, and does not prove that such a stack would be successful elsewhere for the same capacity. But it does indicate that less area than usually designed for a given size of plant is necessary, and that the chimney for 470 horse power based on the empirical formulas now

in vogue might fulfil its purpose with probably half the area. The modern chimney appears to be designed to handle a far greater excess of gas than required with the tendency to even enlarge the area and lessen the height, which tendency would be better if reversed.

Because of poor draft an engineer was called upon to advise in regard to increasing the height of a chimney already 100 feet high an additional 25 feet, and reported adversely, because it would only increase the draft not quite 12 per cent. which would not apparently be enough. His recommendation may have been good, but his reasoning was unsound. Had he said "only increase *capacity* by 12 per cent." it would be correct because draft pressure would be increased by 25 per cent. The area of the chimney was apparently and mathematically ample for the capacity, hence a quarter addition to the amount of pressure may have been safely recommended as a remedy.

As instancing a reverse condition, I encountered a case where the "draft" was poor, although the chimney tested six-tenths of an inch, which is ordinarily very good for six to seven hundred horse power, while much less was to be developed, the reason being that the area was greatly restricted. It had outgrown its intended capacity and additional height to carry off the volume would necessitate raising it to an impractical extent to give relief.

The other day when in a boiler room of excellent arrangement and design, I was for the moment surprised that the superintendent should complain of a very poor draft, as I had seen many chimneys of that size taking care of a much greater amount of power, but his pointing to a ridge 80 feet high sloping to the mill fence, on which was a heavy growth of trees reaching a higher altitude than the chimney, recalled other such instances. But on what grounds does this condition interfere with the otherwise perfect fulfilment of theoretical requirements? And if such cause has effect, might not climate, humidity, prevailing winds and their intensity, as well as the barometric pressure or elevation of the base above sea level have an important effect on the

efficiency of the stack and account for its uncertain performances, even showing different results in the comparison of similar chimneys of the same size and work?

The conclusion of any study for the proper proportions of a chimney will be, as it always has been, a matter of judgment, probably upon a more enlightened basis in the future.

Mr. F. R. LOW of New York writes editorially in the February number of *Power*: "So far as we are able to find, there is a dearth of practical information upon chimney draft. Numerous more or less mathematical treatments of the abstract case are in evidence, but when applied to the actual case involving a lot of factors not considered in the abstract treatment they naturally fail to apply."

This expression is noticeably in line with my opening observation. Mr. LOW, however, has undertaken the task of correllating data to practically determine the friction and resistance encountered by the air in passing through the coal and the gases in reaching the chimney.

Knowing of my purpose to read a paper on this subject to you, he has asked me to especially invite the aid of the members to make a few observations in the plants under your charge and to send the results to him. He desires that the draft pressure be noted in the ash pit, at the rear of the boiler and the chimney, accompanied with some description of the conditions of the case.

Your opportunities to co-operate in this manner he believes are exceptional as he writes further that the scientific spirit attributed to the Association for practical research will make the data thus obtained more reliable than from any other source.

He has printed slips containing the information needed, copies of which are inserted at the end of this paper or can be had by addressing Mr. F. R. LOW, World Building, New York City. On account of inaccessibility to some of the desired locations it may not be practical for every one to fill in all the lines, but if they will do what they can it will be of material value to the sum total.

A correct determination of these factors will be invaluable to the future designer by enabling him to calculate the height based upon knowledge rather than upon present varying theories.

Mr. C. J. H. WOODBURY. This paper on Chimney Design contains information on a class of engineering problems which cannot be solved by rule of thumb and on which there is a lack of desirable information, both on the strength of chimneys as well as methods of computing their capacity. One of the latest books on the subject which has been very freely advertised is so permeated with typographical errors that the value of the work is impaired to the extent which prevents its being taken as authority, except as the various formulae and statements are confirmed by independent calculation.

The PRESIDENT. Gentlemen, the papers prepared for this session have been presented. It is in order for any remarks on the last one or any of them, and I will wait a moment for you to consider.

Next in order are the topical questions assigned for this session:

127. What is the maximum length to put No. 100s on bobbin?

128. How far is it practicable to substitute frames for mules in spinning filling?

That is a question, gentlemen, that has engaged your attention for a considerable time, one that you are thinking much of now, with which many of you are very familiar and doubtless will be very glad to discuss. Are there some of those present who desire to take up that question?

There is a disposition on the part of some to move forward in the direction of spinning finer numbers upon frames. We have a few instances where it is claimed to be done, and I have seen the yarns that are looking very well indeed up to as high as 130s. Of course there are very marked opinions with reference to the relative values of the product, as from mules and frames. I will refrain myself from entering into any discussion, but I shall be glad to hear from others who are interested.

We will pass to the next question:

129. What means have been found useful in diminishing the number of oil stains?

130. What steam pressure should be carried on slashers running on colored work, and what is the best means of returning to boilers the condensation from slashers?

131. What is the quantity of steam properly required for slashers and the best means of applying the same?

132. What is the best method of utilizing the waste products of a mill?

Mr. FRANK M. MESSENGER. It seems to me that it must be very discouraging to the Board of Government to prepare these papers and these topical questions and have all but one of them passed by without notice. Certainly some of these questions must interest the larger part of the members present. Going back to No. 128:

128. How far is it practicable to substitute frames for mules in spinning filling?

I presume the intent of that question is, how far is it practicable, taking into consideration the cost of the yarn as well as the possibility of spinning it on frames, also the practicability of handling it after it is spun. To begin with, the question of handling the bobbins used in the filling and spinning a large variety of numbers makes the use of frames for filling quite an intricate matter as compared with mules. On the other hand, for the finer numbers, frames evidently require a better preparation than mules. There has been some question in regard to

the effect or the "feel" of the goods between mule and frame filling. With what little limited experience I have had, I believe it is possible to produce filling on frames up to 60s, or even finer, that will answer the purposes of mule filling in every respect. What I mean to say is, I believe it is possible to get a very soft twist on frame filling and have tolerably good running work. We have been using it in filling sateens with very good success. But there is a difficulty in using frames where you are spinning a variety of numbers, in having so many different bobbins, using your bobbins and keeping your different numbers of yarns separate so as not to mix your filling. And I would like to hear this question discussed. It is possible, and indeed probable, that a good many members might give us some very good points in regard to this. The method that we have pursued of keeping our different numbers of yarns separate and distinct one from another is by painting the bobbins, having different colors of bobbins for the different numbers. Of course they can be kept separate by marking the boxes, but when filling is dropped on the floor or in any way bobbins get scattered here and there, it is difficult then to detect one number from another. Now that is quite an important point, and if some member or members would give us their experience in this line of keeping the different numbers of bobbin filling separate one from another so as not to mix their filling, some of us might get some light that would be valuable. I believe that if we will use a sufficiently high grade of stock and good preparation so as not to have excessive draft, we can spin filling on frames up to 60s and possibly finer, that will answer the purpose in any style or grade of goods. But our experience has been that in order to do this where we want a soft finish, or soft "feel" to the goods—and that means a lighter twist in the yarn—we have to put a good deal more money into the preparation back of the frames.

We know that the mule has been so far improved in late years and the product so much increased that it is chasing the frame pretty hard on finer numbers of filling in regard to cost of spinning. When we come to the point of adding extra ex-

pense for our preparation, there is a point somewhere, — and that seems to be the question to bring out today, where that point is, — that we can no longer afford to spin our filling on frames but can better afford to spin it on mules. I did not rise to define that point or inform this body where it lies, but it did seem to me that it was too bad to pass these questions over, and particularly a question of this importance.

The PRESIDENT. Will some other gentleman follow this matter?

Mr. JOHN ECCLES. Mr. President and gentlemen, I think we ought to be more interested in these topical questions. They are of vital importance to our meetings. In fact, I think they are the most salutary feature that we have in these meetings,— discussion of such points as these. I feel sorry myself to see them go by and no one rise to speak. There are plenty here, I think, who know more about spinning frame filling than I do, who have not had the experience with filling frames, but I will suggest to Mr. MESSENGER in reference to keeping the yarn separate, that it could be done by having printed tickets. We have printed tickets on our filling, bearing each mule spinner's number, with the number of the yarn spun. I simply mention this, if it would be of any benefit to any one, that we have found it very useful indeed. It keeps a check on mule spinning in reference to making good work. We used to mark the boxes with chalk, but the boxes got so many marks that it was hard to tell who had made the filling. Therefore we adopted this way of having the printed tickets with the number, and it has proved very useful. The ticket lies in the box till the filling is all used up, and most of those tickets are returned so that we can use them over again.

Mr. FRANK M. MESSENGER. Mr. President, we use the same system on our mules that Mr. ECCLES refers to. We use a printed ticket and also mark the boxes in addition. But on the frame filling we find it more difficult in returning bad work, owing

to the bobbins being scattered on the floor and owing to the different class of help employed on frame filling as compared with mules, in keeping the work separate. I have not felt that the system that we employ on the mules would answer on the frames. We have felt it necessary to use a different color for each number of yarn.

Mr. ARTHUR H. GULLIVER. Mr. President, I would like to say one word in regard to this matter. It is absolutely necessary to use a first class staple to spin filling yarn. I think this matter has been talked over in this Association a number of times, and there is one thing that has occurred in my experience within a few months that shows that this is absolutely necessary. The minute you get hold of any stock that is not up to the quality that you have been using on this yarn, that very minute you are in a position where you are obliged to put in more twist. It is not a question of choice; you cannot run without it.

It seems to me this matter is one that we want to take into consideration in addition to the matter of draft. I believe without any question the shorter the draft we have on the filling frame, the better for us; but I do believe without any doubt that we have to use a better grade of stock; that is, one where the staple will come nearly of an even length, and not vary each way from the standard. On everything over No. 60, it seems to be desirable to use combed stock and not try to do anything with the carded material. The minute we make yarn out of inferior material, that very minute we get yarns that we cannot use and a good many times cannot spin.

I think perhaps we have had a chance to judge that a little better in the last two years. Some of the mills that I know, in addition to the ones where I was, found that the stock has been of such kind that you could get almost any length of staple from the same bale; that is, if you got at one end staple 1⅛ inches long, at the other you would get 1¼. That kind of stock is something that will bring a spinning frame to grief as quickly as anything that I know. And it seems to me in looking at this

question as to how far it is desirable to go on spinning a finer and finer thread, the question of draft is one that must be attended to at once. The quicker the fact is understood that finer numbers mean shorter draft absolutely, as well as better preparation, the more satisfactory will be the result in the yarns that are spun on the frame, and the nearer they will come in competition with yarns of the same number spun on the mule. I think perhaps some of the experience that members of the Association have had on filling frames will lead them to believe that filling frames are something that need not only great care but also a great deal of foresight in providing for stock that is sufficiently long and sufficiently even to give an average strong yarn and a medium amount of twist.

The PRESIDENT. If no further discussion on these topical questions is desired, we will proceed to the election of members, to which end I will appoint Mr. FREDERICK A. FLATHER and Mr. ARTHUR H. GULLIVER a committee to distribute, collect and count ballots for the election of members.

Mr. STEPHEN A. KNIGHT. Mr. President, while the ballots are being distributed, I will say that I feel, with Mr. MESSENGER and Mr. ECCLES, that it is a great mistake, it is a lamentable mistake, that there are so many topical questions presented to the Association that are not discussed. I would think it almost advisable, while we would not like to be presumptuous, that it be suggested to the Board of Government that when these topical questions are presented they should require either a short paper from the party that proposes a question, or require him to open the ball for discussion. Very many of these questions are of vital importance, and without doubt the parties who propose them could give us some information, and if they would start the discussion I have no doubt it would provoke controversy with the other members. And I really wish that some means might be devised — I don't know what would be the best method, but we have gone along with this very thing from year

to year, with lots of topical questions that have simply been read from the chair and no discussion on them whatever. Now it seems to me that we had either better dispense with them and fill the place with something that can be discussed, or have some method of discussing them after they are presented to the Association.

The PRESIDENT. Gentlemen, the remarks of Mr. KNIGHT are apropos. They touch a very important question. While the chair is not a proper place from which to discuss them, I cannot refrain expression of a feeling of much regret at the indisposition to take up these questions or to tender some remarks upon the papers presented. The plan of printing and distributing the papers in advance of the meeting has been adopted, for the express purpose of inducing interest and discussion. I am therefore disposed to give emphasis to the remarks of Mr. KNIGHT. If we desire to extend our work or carry it along on the lines which have been proposed and to increase the interest of the Association within what appears as its legitimate sphere, then it is absolutely essential that members shall participate in its work and take part in its discussions even though it is a matter of much disinclination. The papers presented and the topical questions proposed will of course vary in the interest which they will incite among the members, yet it is safe to assume that all of them will contain material which will prove useful and of substantial interest to the Association.

The question as to the relative value of mule or frame filling yarn is one of particular interest. It is a question upon which there are differences of opinion. There are members present who have had large experience, and whose views, if they can be obtained through discussion or otherwise, I feel assured would be valuable and would possibly clear up and harmonize a number of conflicting opinions.

The matter suggested in the remarks of Mr. MESSENGER as to the best system or method of handling the filling bobbins in mills where there is a large variety of work is a very important

one. I am aware of no better method than the one he suggests. It is in quite general use. It is evidently a matter of vital interest that the various numbers of yarn shall be kept separate. Without some careful attention and system, serious trouble obtains through the mixing of filling yarns. It is not only necessary to provide distinct marks for classification which shall readily indicate the various numbers, but it requires careful management and constant inspection within the spinning department and thence through the aging process and distribution to the looms.

There is no question that in the matter of spinning filling upon frames there are involved many important considerations. There are a variety of fabrics in which frame spun filling is preferable, and indeed upon many lines it may be justified. It is however a question to be determined by the character of goods and not infrequently physical conditions and considerations of labor are involved. I have for many years advocated the employment of frames for the spinning of a considerable variety of filling yarn. From such experience and observation as I have had I think the sphere for both frames and mules is limited within the lines determinable of the goods required, in other words, that it would be unwise to indiscriminately substitute frames for mules or visa versa.

I will take no more of your time but submit for your consideration the very important questions suggested and especially the matter proposed by Mr KNIGHT as to the necessity for a greater interest in discussion. His suggestion of reference of the matter to the Board of Government to devise a plan of relief is timely and may prove of much value.

Any plan which shall secure a proper interest and a general participation in the discussion of papers and topical questions will prove of great value to the Association and a matter of deep interest to its members.

Mr. ALFRED E. ADAMS. As to the matter of marking filling bobbins, there is a very simple and efficient way, I think, where there are several numbers of yarn made, and it is not practicable

to use bobbins that are painted; mark them with crayons, such as we mark roving with. Different colors can be used; mark the bobbins on the frames, before the frames are stopped to doff. This can be very easily done so that the color will show upon each bobbin. It will not affect the goods in the least. It has been tried in some instances that I know of with success.

Mr. FRANK M. MESSENGER. I would like to ask Mr. ADAMS where he would put the crayon mark, at the bottom or top of the cop.

Mr. ALFRED E. ADAMS. I would put it near the bottom, anywhere below the rail.

The PRESIDENT. Gentlemen, it is not yet 12 o'clock. On account of the engagements for this evening, it will be desirable that the afternoon session shall be brief. I will therefore suggest that we take up one of the papers allotted for the afternoon. Mr. ADAMS is here; and I request that he will now present his paper upon the subject of Ring Spinning.

RING SPINNING.

ALFRED E. ADAMS, Whitinsville, Mass.

In successfully operating the departments of a cotton mill, it is necessary to secure good overseers, men of judgment and experience, of good character and ability, men who by their example will lead their employees to respect them and improve under their training.

Such overseers *will* devote their whole time during working hours strictly to the interests of their employers. Their aim will always be to manage their departments skilfully, thereby producing the very best results, endeavoring to excel in quality, production and cost.

The employees should be treated with due consideration and kindness, and their rights respected. In this way discipline may be easily maintained and harmony prevail throughout the mill. Close application to business has become an absolute necessity, if full success is to be assured. Every employee has a work to perform. Those directing must see that they understand what their work is and that it is done in a workmanlike manner.

In order to have every department handled with skill, the manager of the mill must be one who understands men as well as the details of his business; that understands human nature as well as his mill; one who gives his orders to the heads of departments in such a manner as to create the feeling that he has full confidence in their ability to execute them; being careful to fulfill all obligations *promptly*, unless absolutely impossible to do

so. Being systematic in everything. Lack of system often ruins a business. The success or failure of a mill depends very largely on the management.

Having referred to the management of a mill and its departments more as an introduction. than otherwise, and as it is not consistent to treat every department fully in one short paper, let us take as the topic for our consideration the Ring Spinning Department, which may consist of ring spinning, spooling, warping, slashing, etc.

In starting new machinery much depends on the overseer, who should be a practical spinner and thoroughly competent to have charge and look after every detail. The ring spinning department is of as much importance and requires as efficient an overseer as any other department. In order to successfully spin fine yarns, especially filling yarns, it is necessary to have the frame carefully built and correctly set up and adjusted. Let us note as many of the important points as possible, the spindle and bolster, ring rails, rings and holders, thread guides, top rolls, ring rails for filling frames, spindle banding, traveler cups and traveler cleaners. We will consider each in the order given.

SPINDLE AND BOLSTER.

The gravity spindle, of some type, is in general use today. Bolsters should fit closely in the rail, not being adjustable. Spindles set perfectly plumb. Whorls should be exact in diameter, distance from center of whorl to center of cylinder shaft alike for every spindle, thus making it practicable to use bands that are marked, and assuring an even tension or pull on the band, when knots are tied on the mark, thus avoiding undue wear and saving power. A common spindle in a rigid bearing confined in a reservoir holder, thus assuring lubrication, has some advantages over a gravity spindle.

RING RAILS.

The ring rails should not be over eight feet in length, and cast so that when finished and placed on frames, they will be

perfectly level on top and straight on the sides, without being peaned. Over two rods to a rail are not advisable. When three are used, the rails are more apt to dwell, causing badly filled bobbins, thus making waste. Especially is this so on filling. A slightly tapered hole on the under side of rail, where it rests on lifting rods, will avoid any binding or dwelling, where two rods are used, due to the frame being slightly out of level.

It is of the utmost importance that the ring rails should be perfectly level and straight, thus making it possible to have the rings level. It is also important that the rails be made heavy enough to avoid any vibration which might be caused by unbalanced pulleys or spring of floors. Too much importance cannot be attached to this part of a spinning frame.

RINGS AND HOLDERS.

The best wearing rings are so tempered that they cannot be cut with a file. The flanges should gauge alike in width and thickness. Also the ribs connecting the flanges should be exactly the same thickness in every ring. The nearer to a standard these dimensions are, the smoother the traveler will run and the longer it will wear, which means less waste, and more spindles run by spinners. The dimensions referred to are of *vastly* more importance than to have rings two or three-thousandths out of round. In fact, a ring slightly out of level on the rail affects the work more seriously than a ring not round. Travelers must fit properly or they will not be durable. It is not practicable to fit them to each individual ring, therefore it is necessary to have the dimensions of rings kept to a correct standard. A traveler is a minute mechanism, and should have a perfect track on which to run. When a ring is used requiring a holder, the *cast iron holder* is the best, and the three-screw adjustment the safest and the most practical in use. When the ring is placed in proper position in the holder and adjusted in the rail using the three screws, you can be assured that the ring will retain its position. When all the rings in a room are prop-

erly adjusted with the three-screw adjustment, they will keep their places.

On the other hand, when a plate holder is used, you cannot be sure that they are in proper position, for they are constantly in danger of getting moved by coming into contact with something. Further, in taking rings out of plate holders, the holders are frequently sprung, consequently throwing the ring out of level. A ring out of level will cause the traveler to vibrate, thus wearing the traveler and ring faster than a traveler running on a ring which is out of round. This has been tested many times and proved to be correct. In putting rings into plate holders, the holders are frequently sprung if the rings are put in taut. Then when placed on the rails and screwed down, they are frequently found to be out of level. Very frequently the rings are found loose in the holders. When it becomes necessary to turn the rings over, instead of loosening the plates and carefully adjusting them, they are pried out and forced back. In this way many of the plates are sprung and remain in this condition. The three-lugged holder is not as practical as the two-lugged. The reason why it is not is because it is more difficult to put the rings into them without springing the holder, and when the holders are sprung they will not set level on the rails. Rings slightly out of round are to be preferred to rings not level on the rails. A No. 1 flange ring is preferable for fine yarns.

THREAD GUIDES.

Thread guides should be made of not less than No. 8 wire and screwed into thread boards as taut as possible. In new frames, the guides should not be turned in so far as when being set, it becomes necessary to draw them out, thus loosening them. The surface that the yarn draws over should be straight so there will be a slight vibration to the thread. This will cause the twist to be thrown back to the bite of rolls. On filling frames this is very essential. Independent kink arresters are most practical, when made adjustable and properly set.

TOP ROLLS.

Top rolls should be uniform in size, and covered in the best possible manner, especially for high speed and fine yarns. The very best of all wool cloth, not less than twenty-two ounces per yard, should be used. The skins should be carefully selected. Cots not drawn on too taut. Cushion is necessary for light weighting of rolls. The rolls will last longer, power is saved and a better quality of yarn assured. Long boss rolls are preferable for spinning yarns up to 60s or even higher. Above 30s the best results are obtained by not weighting the middle rolls, and setting the rolls as close together as the staple will admit of.

RING RAILS ON FILLING FRAMES.

Ring rails on filling frames should traverse slow, when running down, and quick when running up. Running down slow is to avoid any extra strain on the yarn when changing direction. It also assures the use of a slightly heavier traveler, thus winding the yarn on bobbin harder, securing a greater length of yarn. Filling bobbins should never be wet, except they are enameled. Enameled bobbins do not catch and hold the thread as readily when doffing. This means more poor work and more work for the doffers. With a proper friction in shuttle, and fair twist in yarn, say one and one-half to two turns more than standard for mules, with twenty-four hours ageing in the weaving department before being put up to looms, there will be no kinks in the cloth. This has been my experience for more than twenty years, with bobbin filling numbering from 16s to 60s.

SPINDLE BANDING.

Spindle banding should receive careful attention and be made from good strong staple cotton, using an 8 or 10 hank roving. Not twisted hard on fly frames. Put the proper number of strands together, adding a few threads of yarn for additional strength. Twist into one strand of sufficient size to make bands of required weight when taken from banding machine. The

twist should be so adjusted that when bands are completed a fairly soft band and one that will not stretch very much will be produced. The size of bands should be governed by work required of them. Bands should be marked at the point where knot is to be tied. Care should be exercised in having the mark placed so as to give the proper tension when band is on the frame.

TRAVELER CUPS.

Traveler cups are often neglected. Made ill-shaped and frequently not in use, owing to not being properly located, or too few of them. This is wrong, for light weight travelers are expensive, and on high speeds large quantities are used. Suitable traveler boxes should be placed near enough to each other so the spinner can easily reach them without any inconvenience or trouble. They should be so shaped that the travelers when put in may be easily separated and remain so. The boxes should have covers that will automatically close, thus keeping the travelers clean and free from lint, and avoid their being wasted by clinging together when being taken out for use.

TRAVELER CLEANERS.

Traveler clearers of several types are in use. Those cut and turned up on the plate holder are not as easily adjusted as some other types, and as a rule are not found to be keeping the travelers free from lint. The wire clearer, when properly made and carefully placed on the double ribbed ring, which is designed to keep them in place, is the most satisfactory clearer now in use. The lip of the clearer should not stand vertical but at an angle which will allow it to be self-cleaning as well as to keep the traveler clear. And most spinners will admit that travelers should be kept clean automatically, without resorting to the use of traveler brushes or the old way of picking the lint off the travelers when doffing.

The topics which are introduced in this paper for discussion

are all worthy of careful consideration by those who are desirous of spinning fine yarns successfully. Not one should be neglected. No spinning frame has yet been built as perfectly as it should be, or will be in the near future. The most exact workmanship on every part of a spinning frame mentioned in this paper, *is necessary*, if the art of spinning is to be brought up to the highest possible standard.

If we are to attain the highest possible standard, we must know what we want, and see that we get it. The topics introduced have been touched upon but lightly, and in such a way, it is hoped, as to make them worthy of thought and discussion.

The SECRETARY. Mr. President, I beg to call the attention of the meeting to the memorial volume to the late President FREDERICK E. CLARKE, which has been prepared by his friends in Lawrence. Mr. J. C. CROMBIE is here and he has several copies, if any of the gentlemen wish to purchase them at one dollar a volume. Mr. CROMBIE can be seen here at the present time or after the adjournment of the session.

The PRESIDENT. Gentlemen, the time has arrived, when we had better suspend this meeting, and I will therefore declare this session adjourned until two o'clock this afternoon.

FOURTH SESSION.

THURSDAY AFTERNOON, APRIL 26, 1900.

The Association met in Chipman Hall at 2 P. M., President THOMPSON in the chair.

The PRESIDENT. Gentlemen, you will kindly take seats and come to order.

The time is now quarter past two o'clock. Members have laid out so much for the afternoon and evening that we will be as brief as possible. The first paper in order at this session is The Harriman Automatic Loom, by Mr. HENRY I. HARRIMAN of Hyde Park, Mass.

THE HARRIMAN AUTOMATIC LOOM.

HENRY I. HARRIMAN, Readville, Mass.

It may safely be asserted that at the present time no subject is receiving more careful consideration than that of weaving. In its essentials the power loom has changed little since the date of its invention. It has been made heavier, the details of the let-off and the take-up and the numerous other parts have been changed in their degree of efficiency, but little in their method of operation. Yet from the beginning of the century it has been clearly foreseen that a most radical change in weaving would take place upon the invention of a simple and efficient weft supplying mechanism. Also as the speed and number of looms per weaver has increased there has been a growing demand for a warp stop, and it is asserted on good authority that the venerable Dr. CARTWRIGHT himself built such a mechanism. In 1825 we find a patent issued to Stansfield, Pritchard & Wilkinson for a warp stop consisting of drop wires which were used both as harness heddles and as warp detectors. MCFARLANE in 1857 patented in the same loom weft supplying and warp stop mechanisms. BULLOUGH did the same in 1866, and the decade from sixty to seventy reveals between forty and fifty patents along either or both of these lines. But following 1870 there was a very general absence of work on automatic looms until there appeared that remarkable series of inventions perfected by the Draper Company.

In the case of weft supplying looms the difficulty of transferring such a large body as a shuttle, in the very short period of

time given between picks, prevented their general use. The process was destructive both to the loom and the shuttle, and it is safe to say that none of these numerous inventions was ever put to practical use. As to the warp stop, it has changed little in thirty years and only awaited the perfection of devices which could produce the infinitely fine and thin wire that is used today. The round wire as used in the sixties occupied far too much room for any but the coarsest of cloth. Moreover, it was lacking in the delicacy of temper and the nicety of finish which characterizes our present heddles.

The chief feature of novelty claimed for the loom which is the subject of this paper is the fact that ample time is taken for the resupplying of filling. To secure this end three methods have been adopted. The loom is brought to a complete standstill, a filled shuttle exchanged for a spent one and the loom automatically restarted; or the picking is suspended for a series of picks, the speed of the loom reduced to fifteen to twenty revolutions per minute, the shuttle changed and the loom restarted at its normal speed; or lastly, the picking is suspended and the shuttle shifted from the stationary magazine to the moving lay, ample time being given for such operation because of the suspension of the picking. In this paper more particular attention will be given to the stopping loom, as, for a new loom running at high speed, I believe it to be the most efficient of the three mechanisms.

On the exhaustion of the filling from a cop or bobbin the filling fork acts to stop the loom in the customary manner, causing the belt to be shifted from the tight to the loose pulley. At the same time a shaft, which we will term the magazine shaft and which is located at the rear of the back girt and about eight inches from the floor, is set in operation by a mechanism connected with the loose pulley of the loom, and caused to make one revolution while the loom is still. Cams on its magazine end operate levers which open the front of the shuttle box, eject the old shuttle, and insert from a hopper on the breast beam a new shuttle filled with weft. Then a cam on the driving side of

this magazine shaft operates directly upon the shipper handle, shifting it from the loose to the tight pulley, thus restarting the loom. In these operations, which are entirely automatic, the weft is supplied in about four seconds, while if the loom was running the change must be effected in a fraction of that time. It will thus be seen how easy is the action both on the loom and on the shuttle. It is a trite saying of mechanics that anything can be accomplished provided only sufficient time is given; and this is especially true of looms. Instead of the jar and the shock which must follow the change of either a shuttle or bobbin during the moment of time given while the loom is running, there is an easy and gradual opening of the front of the shuttle box, the deliberate pushing out of the spent shuttle and the equally deliberate insertion of the new one. The operation is as easy as when performed by the hand of the weaver and the injury to the shuttle no greater.

Experience has demonstrated that the speed of all automatic looms now running must necessarily be less than the speed of the modern plain loom. It is doubtless possible in an experimental way to run a shuttle or bobbin shifting loom at a speed of 200 picks a minute, but no mill in the country has ever succeeded in doing so day in and day out, week in and week out,—yet how numerous are the cases where for years at a time whole rooms of common looms have averaged this great speed. In the case of this automatic loom it can be readily seen that there is no relation between the speed and the mechanism supplying the filling. They are entirely separate and distinct, one running only while the other is still; and as the loom must stop to change its shuttle it is clear that the change can take place as easily in one whose speed is 225 as in one running 100 picks less. I believe that this loom can be run at the highest possible speed attainable by a plain loom, its speed being limited only by the character of the fabric woven.

Let us now consider the loss of production which must follow the stopping of the loom during the change of shuttles. If the filling is changed 125 times a day the total loss of weaving time

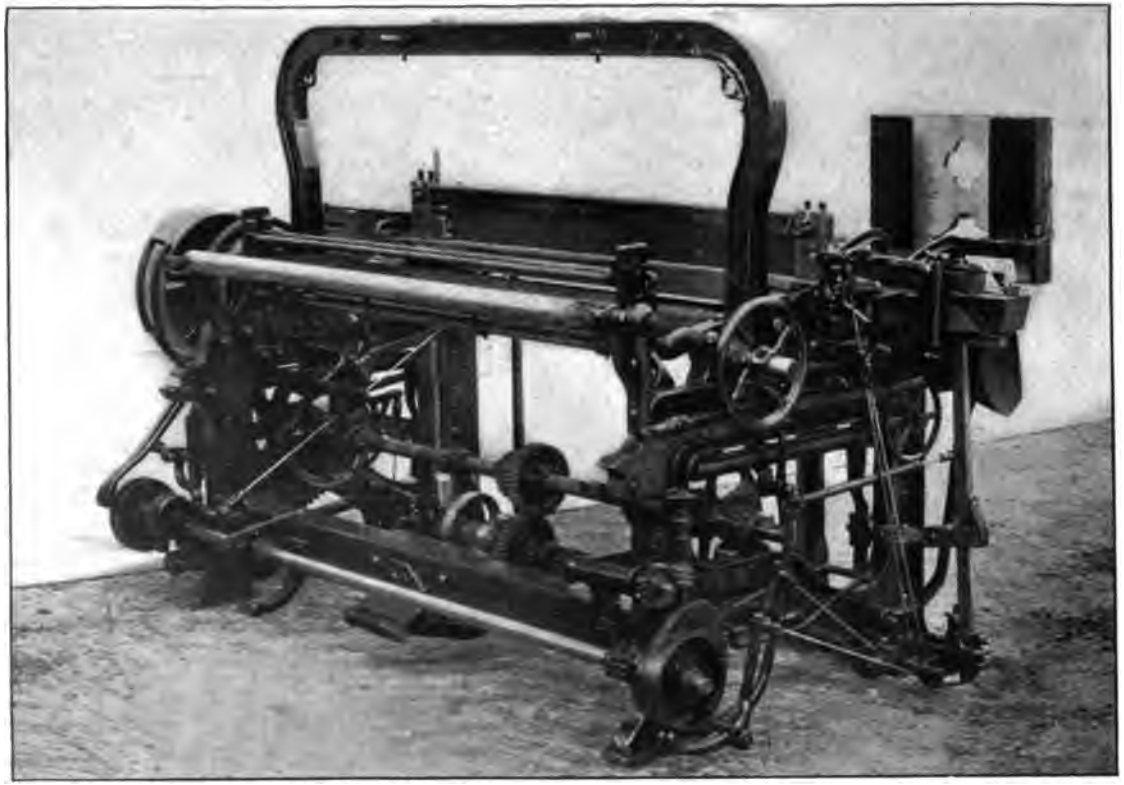


FIGURE I.

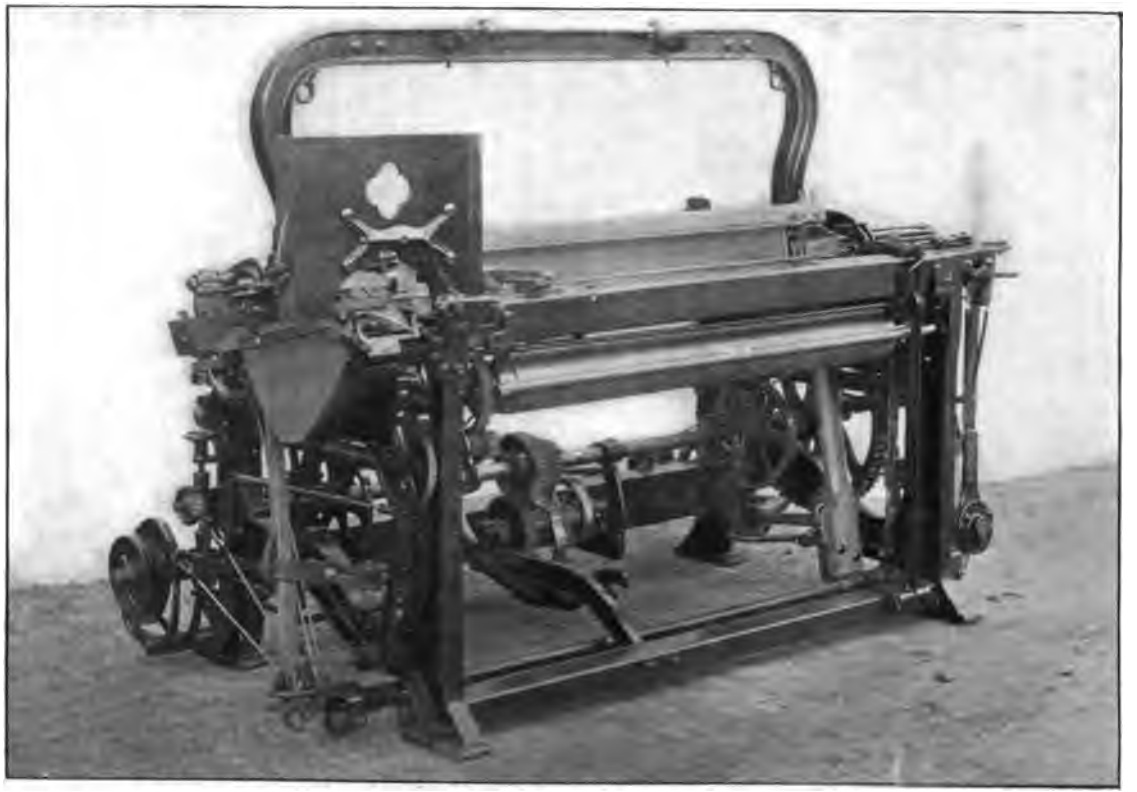


FIGURE 2.

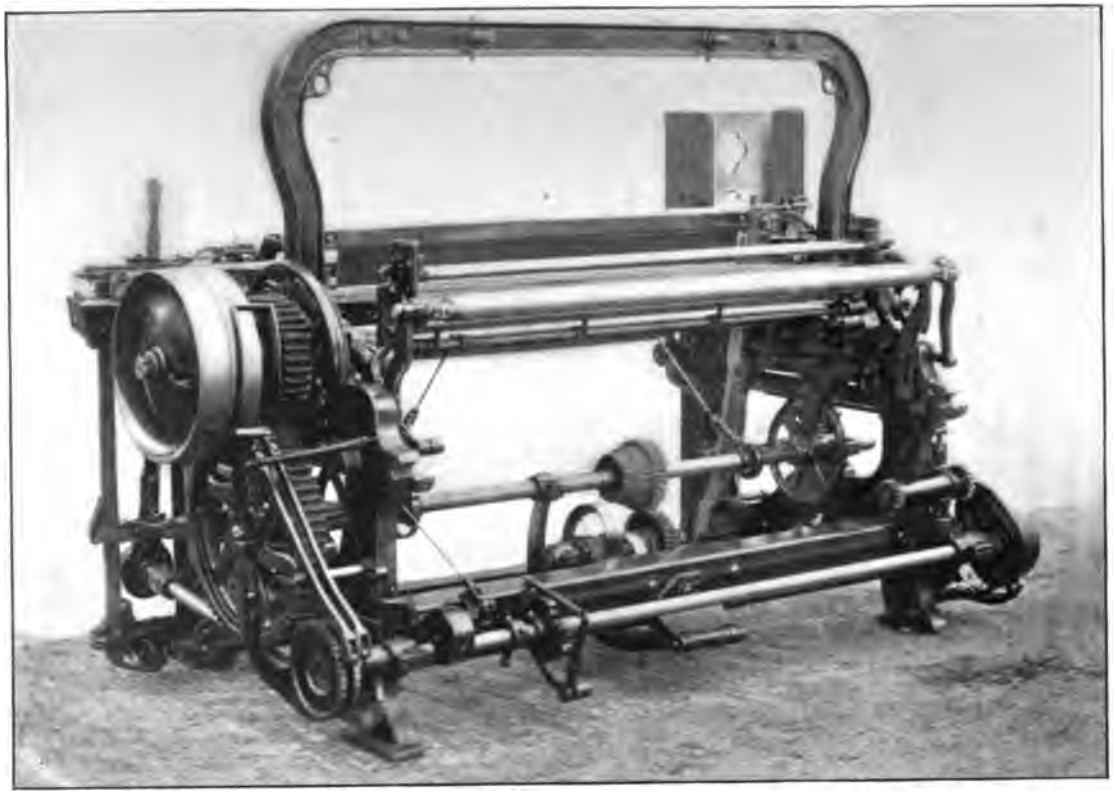


FIGURE 3.

due to shuttle shifting will amount to 500 seconds or 8⅓ minutes. With a loom running at 200 picks a minute this will mean a total loss of less than 1,700 picks, and as a weaving day consists of 600 minutes, it is obvious that the loss per minute amounts to less than three picks. Hence it is clear that if this loom runs three picks faster than one supplying filling without stopping it will weave the same quantity of cloth. Is it not equally apparent from the nature of the mechanism that it will not only make good this loss but gain an additional fifteen or twenty picks?

Section hands should have little trouble in the care of this loom, as in all its essentials it is run exactly as is the common loom — the magazine parts having very few points of adjustment and very little delicacy. Ordinary rebounding of the shuttle has no effect upon the change of weft, in fact, had the shuttle rebounded three-fourths of an inch on its last pick it would be ejected as easily as were it entirely home. Then, too, the cams on the magazine shaft are splined in a definite position and can not be moved or tinkered with; and the deliberation of all the weft supplying operations consuming about eight minutes per day assure practically unlimited wear and guarantee a minimum of breakage. It may be of interest to note that in several cases these looms have been sent to mills and started by fixers who were entirely unfamiliar with the mechanisms.

Common bobbins and shuttles are used and cop and bobbin filling run equally well.

As to shuttles, eight comprise the ordinary set and the American Loom Company has a contract with its shuttle makers in which they guarantee that the shuttles of these sets shall not vary in weight more than one-fifth of an ounce and shall be exact mates in size. Moreover, this company makes a hand threading shuttle which obviates the necessity of sucking the filling through the delivery eye and expedites the filling of the hoppers. These shuttles are sold at the regular prices of the American Shuttle Company and while their use is recommended it is not essential.

The manufacturers of this weft supplying mechanism also apply it to old looms in the mills or to the new looms of other manufacture. Thus far it has been applied to the Mason, Whitin, Lowell, Lewiston, and Kilburn & Lincoln looms, and no difficulty has been experienced.

The adaptation of an automatic loom to the weaving of twill or dobby goods necessitates mechanism to prevent miss picks, and the means adopted to this end are the natural outgrowth of the method of resupplying weft. While the loom is still it is practical to bring into play many operations which would be absolutely impossible on a running loom, and advantage has been taken of this fact. At both sides of the loom are filling forks, the customary fork acting in its usual manner to stop the loom, the other fork being connected with devices which will be shortly explained. Should the filling break as the shuttle is passing towards the driving end it is obvious that the regular fork will act to stop the loom after it had run but one pick. Should the filling break as the shuttle is travelling away from the shipper side, the loom will not be brought to a standstill until it had made two complete revolutions. Thus it is obvious that in the former case the loom must be turned backward one pick to find the shed in which the filling broke, and in the latter case it must be reversed two picks. It is, however, unadvisable to attempt to turn the entire loom backwards and this necessity is obviated by automatically disengaging a clutch connecting the cam and jack shafts and turning the cams backward any desired amount.

Time will not permit a full description of this mechanism; suffice it to say that should the filling break as the shuttle is travelling towards the shipper side, the harnesses will be turned backward one pick while the loom is still during the change of shuttles. Should the filling break as the shuttle is travelling in the opposite direction the harnesses will be doubly reversed. As these operations are entirely automatic it will be seen that under all circumstances the first pick of the new shuttle will enter the shed in which the previous filling was exhausted and there

will thus be a partial double pick but no miss pick. By a proper adjustment of the compositing pawl and the let off this double pick will not be noticeable; and for the majority of common twill and multiple harness goods this method of pick finding is satisfactory. As is well known, on many classes of goods the weaver does not take the pains to accurately match the filling but after springing the loom to the proper position throws her shuttle through the entire shed, doing by hand what is here done automatically. It is not claimed that this system of pick-finding is perfect for all grades of goods; but that is does apply to many has been shown in actual operation; and its advantages are, that it gives no waste of filling, that it requires no special bobbin or shuttle, and that its mechanism is exceedingly simple.

Instrumentalities have been devised in connection with the temple by which the thread which must necessarily extend from the selvage of the goods to the magazine is cut, and if for any reason the old shuttle should be expelled before it is completely exhausted, this thread will likewise be severed, and a clean selvage guaranteed. No novelty is claimed for thus combining a thread cutter with a temple as it has been done in many instances in the past.

The warp stop is located near the lease rods of the loom and consists of a spring actuated vibrator and a thin drop wire suspended on each warp thread. Should one of these threads break its wire will drop in the line of action of the vibrator and the loom will be stopped. The principle of this warp stop is old, but special devices have been introduced making it unnecessary to hold the fallen wire edgewise to the striker.

There are, however, many classes of goods in which the use of a warp stop is of doubtful advantage as the loss of production due to the stopping of the loom more than compensates for any advantage arising from the better quality of cloth. To obviate this loss and at the same time assist the weaver in watching for faults in the warp The American Loom Company is making a warp signal device. Drop wires similar to those in use on a

regular warp stop are used and upon the falling of a wire on the breaking of a thread a signal is given to the weaver that the loom needs her attention. Upon seeing this signal the weaver at once goes to the loom, stops it, repairs the damage and restarts it. The advantage of this mechanism is that without loss of production the weaver is given instantaneous information of the breaking of a thread and is relieved of all care in watching her work. Moreover, the device is such that the weaver if busy on a job can stop any one of her set of looms from any other loom; by a move of her hand she can stop it from any position in her alley.

In closing let me say that the fundamental characteristic of this loom is the time element and its operations are easy because they are slow and because they are independent of the weaving functions. The use of common shuttles, common bobbins, and common supplies of all kinds, the interchange between cop and bobbin filling, the high speed of the loom, the simplicity of setting and method of finding the pick are all directly connected with and largely due to the fact that ample time is given for all operations.

Now, gentlemen, let me thank you kindly for the privilege of presenting this paper, and allow me to say in behalf of the American Loom Company that it is always a pleasure to show the factory to anybody who can come to the factory at Readville, which is nine miles from Boston. We have the looms running with the warp stop and several other devices.

The PRESIDENT. Gentlemen, are there any inquiries to be made? Mr. HARRIMAN will be pleased to answer. If not, we will pass on to the next subject, Cotton Mixing, by Mr. FRANK M. MESSENGER of North Grosvenordale, Conn.

COTTON MIXING.

FRANK M. MESSENGER, North Grosvenor Dale, Conn.

It may properly be said that the selection and mixture of cotton is the foundation upon which rests all subsequent processes in the manufacture of cotton goods, and our English neighbors, recognizing this fact, have given greater attention to this particular branch of the business than is usually practiced in America.

The proper selection of cotton to secure best results at the lowest cost necessarily varies; first, on account of the condition of the plant to be operated; and second, the market value of different cottons from one year to another; hence the proper selection of staple is not a fixed thing and does not come within the scope of this paper. Our title, "Cotton Mixing," suggests a plan or system for handling same after selection has been made; we will therefore endeavor to stick to our text. In the main, the plan outlined is one which is in use at the mills of the Grosvenor-Dale Company. It was first used, in a crude way, by the writer of this paper while employed as an overseer of carding, over twenty years ago, and is, as far as he knows, chiefly original with him. It has been elaborated, adapting itself in some instances and taking on, with certain modifications in others, the plan of grading, tagging and storing cotton which is in use at the mills above cited; but he has departed from it wherever an improvement could be made rendering it more elastic to fit varying conditions.

Our purpose is to present a plan or system, whereby uni-

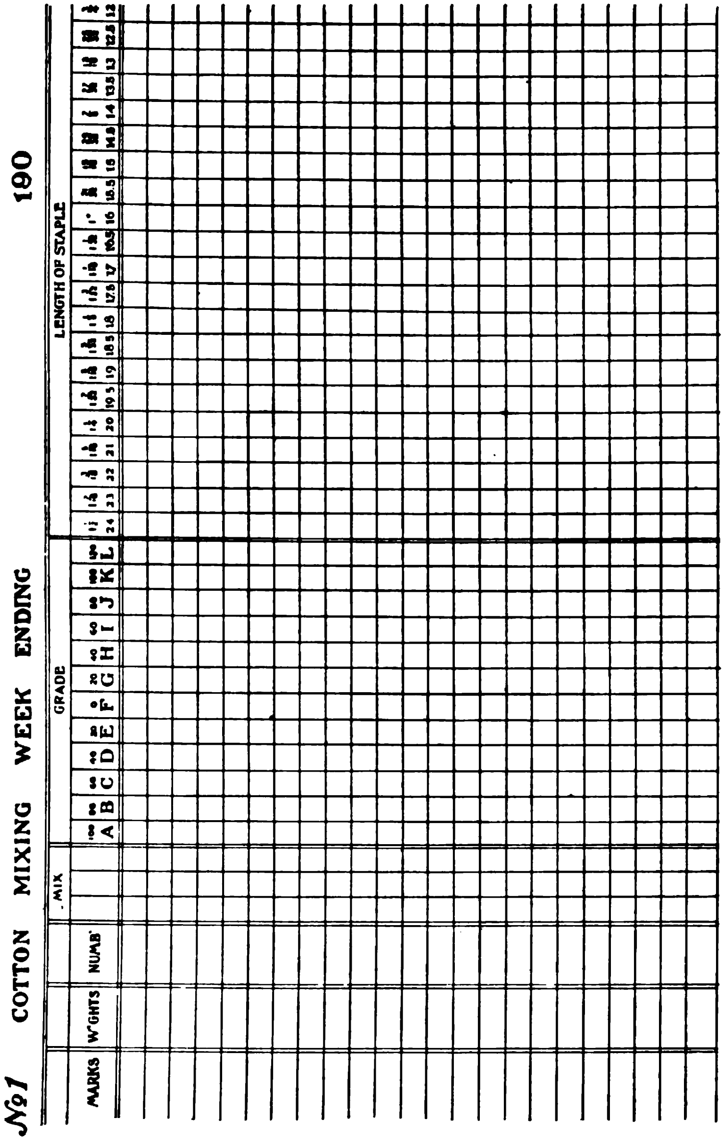

No 1 COTTON MIXING WEEK ENDING 190
MARKS
W'GHTS
NUMB'
MIX
GRADE
A B C D E F G H I J K L
LENGTH OF STAPLE

CHART No. 1.

formity of mixing may be maintained, with a record showing what variations occur. If a wide range of numbers of yarn are to be spun, it is quite probable that several classes of cotton will be used and each class should be considered wholly independent of the others.

If different *kinds* of cotton are to be used in any one class, there will be three conditions to be considered, namely, average "mix," average "grade," and average "staple;" but where one kind of cotton is to be used, only the last two conditions need to be considered.

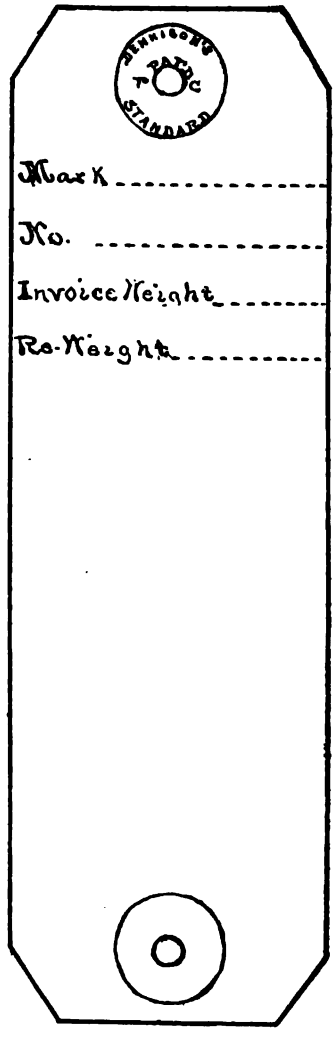
Chart No. 1 shows a blank form providing for the entry of each individual bale as it is opened. This form is abbreviated, that is, a longer page should be used providing for not less than 50 bales; this however gives the headings and serves to show the principle.

In the first column at the left we enter the bale marks. These should consist of three characters; letters of the alphabet are preferable, the first letter to denote the grade, the second the purchaser, or locality where purchased, and the last letter to denote the lot. Next we have a triple column for the "mix," to be used where two or more kinds of cotton are mixed together. The next subdivision is for the grade, and using the letters of the alphabet, we apply them as follows:—

Grade A,	Fair,	100% plus.
Grade B,	Middling Fair,	80% plus.
Grade C,	Strict Good Middling,	60% plus.
Grade D,	Good Middling,	40% plus.
Grade E,	Strict Middling,	20% plus.
Grade F,	Middling,	0%
Grade G,	Strict Low Middling,	20% minus.
Grade H,	Low Middling,	40% minus.
Grade I,	Strict Good Ordinary,	60% minus.
Grade J,	Good Ordinary,	80% minus.
Grade K,	Strict Ordinary,	100% minus.
Grade L,	Ordinary,	120% minus.

We have chosen to use "middling" cotton as standard, considering it as zero, rising 20 per cent. per each half grade to the highest, and dropping from it 20 per cent. per each half grade to the lowest.

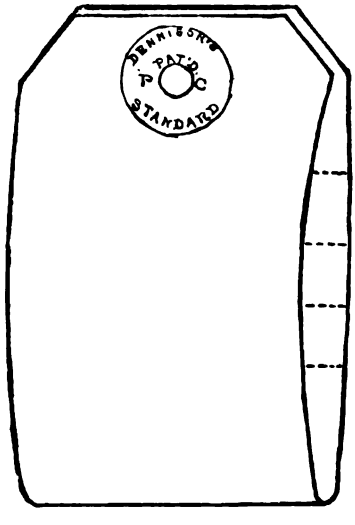
The next and last subdivision is for length of staple. Begin-



CUT No. 3.

ning with one and one-half inch, represented by $\frac{24}{16}$, we drop by sixteenths to one and one-quarter inch, and from one and one-quarter inch we drop by thirty-seconds down to three-quarters inch. It will be noticed therefore that the length of staple is considered by sixteenths of an inch rather than by inches. Doubtless the metric system would answer better here but we have not used it as its terms are as yet unfamiliar with this country.

Having a system for grading and stapling, the ship samples should be examined in detail as each lot is received, making a record of same with an average of the grade and staple as hereafter explained for the mixings. As cotton is received each bale should be retagged. We have used a double end tag as shown in cut No. 3. After letters and all data are entered, the tag should be doubled together as shown in cut No. 4, having all the data on the inside, except the bale mark which should be also stamped on the outside, so that all the figures and data are protected from becoming defaced or obliterated. Cotton



CUT No. 4.

should be put into storage with a view to convenience in taking out again for mixing, then with quantity of each kind before us, the general character of same having been determined by examination of ship samples, we can plan our mixings from week to week with remarkable accuracy. It is a noticeable fact that picking machinery will not clean quite as well in summer weather, and the grade can therefore be run a little below the average in winter, giving a little higher average for the summer months. It is the writer's practice to make the mixings sufficiently low for about nine months of the year, so as to give five to ten per cent. higher average grade for the remaining three months. The cotton having been received, and stored so that each style and grade are easy of access, each class (if more than one is to be used) must be considered separately, and the quantities of each opening or mixing be made up proportionately of each varying element of grade, staple, and kind of cotton to be used. To illustrate: we want to make a mixing for Nos. 40 to 50 warp yarn, and 50s to 60s filling, and we are to use American cotton, bought for 1 1/4 inch staple and averaging a little under "strict low middling." Chart No. 2 shows a practical application of the system. Nominally only three grades are used, six bales are supposed to be F, or middling cotton but three only prove to be of that grade while two prove to be H, one grade below and one bale E, a half grade above. Six bales are nominally H, or "low middling," but prove as follows: one F, three G, and two H. The last eight bales were bought for G, but prove to be four G, two H, and two I.

The total opening foots up as follows: one bale E, four bales F, seven bales G, six bales H, and two bales I. To compute the average grade we multiply the percentage of grade in each instance by the number of bales, first, of all below grade, adding same together, and second, by all above grade, adding together likewise, deducting the less from the greater and dividing by total number of bales opened, the result obtained will be the average either above or below grade as the case may be.

CHART No. 2.

No 2 COTTON MIXING WEEK ENDING April 28 1900

MARKS	WEIGHTS	NUMS	MIX	GRADE A	B	C	D	E	F	G	H	I	J	K	L	LENGTH OF STAPLE 1" 24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
F.R.D	501	1							X											X												
F.O.R	504	26									X								X												
F.O.B	503	21							X											X											
F.O.B	500	36							X											X											
F.A.C	506	20									X										X										
F.A.E	507	19						X											X												
H.A.B	499	80							X											X											
H.A.B	520	89								X									X												
H.E.D	510	1									X									X											
H.E.D	512	9								X								X													
H.B.R	520	90								X										X											
H.A.D	530	10									X										X										
G.A.D	500	3								X										X											
G.A.D	501	6								X										X											
G.A.B	495	80								X									X												
G.A.R	530	73									X									X											
G.A.R	512	74								X								X													
G.A.R	501	60										X								X											
G.E.R	505	3										X									X										
G.E.R	519	2									X								X												
								1	4	7	6	2						2	5	10	3											
								24 % —										20.37														

EXAMPLE.

2 bales 60% below, = 120% minus.
6 bales 40% below, = 240% minus.
7 bales 20% below, = 140% minus.

Total, 500% minus.
1 bale 20% above = 20% plus.

deducted from above = 480% minus.

divided by 20 bales total equals 24% minus, or 24% below Middling cotton.

In computing the staple, we get the average as follows:

2 bales at $\frac{22}{16}$ths = 44.0
5 bales at $\frac{21}{16}$ths = 105.0
10 bales at $\frac{20}{16}$ths = 200.0
3 bales at $\frac{18}{16}^{1-2}$th = 58.5

Total, 20 bales divided into sixteenths of an inch staple. 407.5 = 20.37, or 20.37

Where a mix is to be made or two or more different kinds of cotton, it would be convenient to have all data of each different kind entered together; that is, details of each bale of each different kind entered in consecutive order. The characters denoting the kind of cotton should be entered at the head of the columns and for each bale enter a cross under its designated style.

In computing the percentage of each kind of cotton used in the "mix" if close results are desired, the weights, instead of bales should be used, as packages of foreign cotton do not often correspond in weight with those of American cotton; in fact with so many new styles of baling, a stock of American cotton may have great variations in weights of bales and in such case, the weights must be used to compute the percentages of "mix," "grade," and "staple." With a record of every mixing, of each different class of cotton, entered week by week in a book kept for the purpose, things that are now unexplainable in some mills, could easily be accounted for, and if the fluctuations in

the average length of staple and average grade of same are reduced to a minimum, as they may be by this system, other things equal, the variations in the sizings of yarn in some mills could be reduced very materially.

At the mills above referred to, we have a young man in the office whose business it is to examine and report on each lot of ship samples as they are received; examine, class out, and report on all cotton as it is opened and, if claims are to be made, draws samples to present with the claim; sizes all the yarns of each mill and follows the weights of the different styles of goods manufactured. We make from thirty to forty different styles of goods, varying from a light weight pocket handkerchief or cambric to heavy sheetings and sateens. Our warp yarns run from 20s to 55s, and filling yarns from 18s to 70s. We allow two per cent. variation in the weights of the goods and we rarely have to vary the filling yarns to keep within the limit, but, should a change in filling yarns be necessary in any style of goods, *all* the filling yarns entering into that style must be changed and not a portion of the spindles assigned to it, striking an average, as is practiced in some places. The importance of uniformity all through the different processes of manufacture is readily appreciated, but wide variations in the general character of cotton opened one time with another, so affects each subsequent process that the evil cannot be overestimated; yet we find great care taken, constant weighings and testings of the slivers all through the different processes, while the greatest indifference is often exhibited with relation to this most important part.

Possibly to many, this paper has brought no new light. In fact it is quite possible that a better plan for accomplishing the same end is in use in many of the mills here represented, but where no system is in vogue other than to open a pro rata number of bales from each buyer or locality, guessing that we have struck it right because we bought the cotton for a certain thing, or worse yet, to store the cotton haphazard as it happens to come in, and then let a yard overseer pull it out and open it

in the easiest possible way regardless of uniformity of mixing, is an outrage on the whole success of the mill. It may be urged that such a system for handling cotton is too intricate and laborious and not worth what it would cost, but any company who has not a system that will accomplish what this does, who will adopt this, will find it one of the best paying investments that they ever made.

Run your cotton mixings evenly one week with another if you have not been doing it, and you will find one of two things possible, either to maintain a better running mill with a consequently larger and more perfect product, or ability to use a little cheaper cotton, meaning a saving of possibly an eighth of a cent per pound on all your purchases.

The PRESIDENT. The next subject is, The value of a Horse Power, by Col. Samuel WEBBER of Charlestown, N. H.

THE VALUE OF A HORSE POWER.

SAMUEL WEBBER, Charlestown, N. H.

My attention has been recently called to the question noted above, by a paper read by Mr. GEO. L. ROCKWOOD of Worcester, before the American Society of Mechanical Engineers, and it leads me to bring the question before the Association in these forms, dividing it as follows: Do you know how much your power costs you per annum, either steam or water? What per cent. of the cost of labor and other expenses do you pay for power; and if you should move an inland mill to the seaboard, to save cost of freight and coal, might that saving not be overbalanced by the extra cost of labor, and other expenses not covered or affected by freight charges?

Mr. ROCKWOOD'S paper is a short analysis of the evidence given by a number of well known engineers, in the various cases of suits brought by the mill owners on Blackstone River, against the city of Worcester, for the abstraction of the water of Kettle Brook for municiple purposes, and the average value of a horse power was summed up by Mr. KENT, one of the engineers, as being $50 per annum, or the cost of replacing it by steam.

This agrees exactly with the conclusion which I came to myself, long since, as the fair cost of small steam powers in New England, but it is confronted by a different set of statements, made by other engineers, as to the cost of steam power in large quantities, where these engineers have been employed by mills who sought an abatement of taxes, and a depreciation of the value of their water power plant, and in these cases the engi-

neers have assumed that power in large masses of 1000 horse power or more, could be furnished on the seaboard, by engines and boilers of modern construction, for a *maximum* of $20 per horse power, and from that to much lower cost.

With the latter I do not agree, and unless the manufacturing establishments are of such a character as to require a large amount of low pressure steam for dyeing, bleaching and similar purposes I am inclined to think that the *minimum* cost of steam power should be taken at about $20 except in cases of very large powers, for it is a well established fact, that the cost of a steam plant diminishes per horse power in the inverse ratio of its increase in size, and the cost of operation diminishes in the same direction. It does not cost four times as much for an engineer to run a 1000 horse power engine as it does for one to run 250. The cost of firemen and laborers seems to diminish also per horse power, and the cost of fuel also appears to be less as a general rule.

I had occasion a few years since, when employed in one of these appraisement cases, to endeavor to get the actual cost of a horse power of steam, from a favorably situated mill, which was using steam for power only, and without reference to the use of exhaust for heating or any other purpose. These facts I obtained from Mr. ARNOLD S. SANFORD of Fall River, for an engine of 1050 horse power during the months of April, May and June 1893, when the engine, a compound condensing one was so run. The cost of the plant, engine, boilers, etc. was given me as $66,000, or $62.83 per horse power.

Coal burned in 73½ days, 1,527,000 pounds at $3.70 per gross ton, or $2,519.55. Labor $555.50, oil and supplies $76.50, being a total expenditure of $3,157.55 for the 73½ days, equal to $13.25 per horse power per annum for coal, labor and supplies. To this I add charges on cost of plant as follows, giving in parallel columns, results since attained by Mr. F. W. DEAN and the late Dr. CHARLES E. EMERY.

	Webber. "Gross." 1050 H. P.	Dean. "Gross." 1132 H. P.	Emery. Net." 1000 H. P.
Coal, per Horse Power, per annum,	$10.60		$11.80
Labor, " " " "	2.33	$13.90	2.57
Oil and Supplies, " "	.32		.80
Sinking Fund for depreciation, 5 per ct.,	3.14		
Repairs, 2½ per cent.,	1.57	6.77	7.94
Interest and Taxes, 6 per cent.,	3.77		
	$21.73	$20.67	
Add for loss in engine, 10 per cent.,	2.17	2.07	
Net Horse Power,	$23.90	$22.74	$23.11

I have probably allowed one half of one per cent. more for repairs than either of the other gentlemen, making my total a little higher, but the general agreement is sufficiently close. To these I might add the following list of actual costs as collected by Mr. R. S. HALE for Mr. EDWARD ATKINSON, the different mills being designated only by letters.

	Horse Power.	Coal.	Labor.	Expended, including interest and depreciation	Total.
Mill designated A,	1250	$12.00	$1.52	$4.04	$17.56
" " B,	600	19.50	3.01	6.10	28.61
" " C,	917	12.61	3.67	9.59	25.87
" " D,	1239	12.59	2.10	4.16	18.85
" " E,	770	15.49	2.74	4.50	22.63
" " F,	1300	11.07	2.27	4.55	17.89
" " G,	1431	17.11	3.11	4.77	24.99
" " H,	1055	15.82	3.25	7.31	26.38
" " I,	865	14.14	3.06	4.04	21.24
" " J,	920	15.75	2.32	8.97	26.04
Average, corroborating previous figures,	1034.7	14.608	2.705	5.803	23.116

Interest and depreciation included at ten per cent. on machinery and six per cent. on buildings.

The great discrepancy in these returns will be noticed at once, mill A giving a very low cost of labor, B and G a very high cost for coal and C, H and J very high general expenses, and if as is probable, the power was taken from indicator cards, ten per cent. should be added to get the cost as delivered to the machinery, as it is from a water wheel, which is estimated from its results, and not from the water applied to it.

In a recent number of the Engineering Magazine, it is stated that in Italy the cost of 500 horse power has been found to be about $30 per horse power, while in small quantities of a few horse power it would rise to $150 per horse power.

It is also stated in the same number of the Magazine, that while as low as $20 per horse power had been reported in England, yet that $45 per horse power would probably represent the average cost more closely.

My son, Mr. WILLIAM O. WEBBER, has prepared a "*graphic diagram*," showing the variation in the cost of steam power, due to difference in size of plant, deduced from the results obtained, and the estimates made, by Messrs. CHAS. E. EMERY, F. S. DEAN, R. S. HALE, CHAS. T. MAIN, and myself, at different times and places, covering a long series of observation, and so nearly as I can reduce this curve to round numbers, it gives the cost as follows:

For 100 H. P.,	$63.00	For 800 H. P.,	$26.00
" 200 "	45.00	" 900 "	25.00
" 300 "	37.00	" 1000 "	24.00
" 400 "	32.00	" 1500 "	22.00
" 500 "	29.00	" 2000 "	21.00
" 600 "	28.00	" 2500 "	20.00
" 700 "	27.00		

These figures are supposed to represent *net horse power* delivered from the engine.

As above noted, these costs would be very much reduced in cases like those of the Amoskeag, Manchester, and Pacific Mills, where a large boiler plant is always required to furnish low

pressure steam for dyeing and bleaching purposes, and where the cost of power would be reduced to charges on engine and additional boilers, wages of engineer and extra firemen, and coal consumed in raising pressure from 30 to 120 pounds and the steam used for dressing yarn or heating mills, say from $3.00 to $5.00 per horse power, should be deducted or added to the cost of water power in making comparisons.

I have previously submitted to the Association a paper on Water Power and Its Development, in which I gave the cost of some modern water power plants, as compared with the great expense entailed at Lowell, by the enlargements necessitated by insufficient original plans of water ways, and the desire to obtain the benefit of the large amount of surplus water, which for a portion of the year ran by unused, the result being that turbines equal to 18,000 horse power had replaced the old breast wheels of 10,000, and I now submit this paper showing the actual results of examinations into the cost of steam power, that they may be compared with the previous statements based on picked firemen, selected coal and clean boilers, which have been employed to deteriorate the value of water privileges, and to use as a basis for the claim that steam is cheaper than water. All knowledge is valuable at some time, or to somebody, and any facts which members of this Association can contribute to the general stock from their own experience will doubtless be of future value, though it seems to me, after long examination that no such thing as a general standard, for the "Value of a Horse Power," can be determined, and that it is a matter which is controlled by situation, circumstances and demand.

The PRESIDENT. The following topical questions are in order:

133. What is the best method of treating belts and their proper use?

134. Is it advisable to warm picker rooms with air drawn from the main mill?

135. Are automatic heat regulators an advantage both in economy and comfort?

136. What is the best method of cleaning mill windows?

138. What is the best method of introducing kerosene oil into boilers, and what have been the results from its use?

139. Do water tube boilers contain advantages for steam plants in mills?

140. Do separators remove enough of the oil from condensed steam to prevent all injury to the boilers?

It is evident that you have no desire to discuss these topical questions, therefore they will lie over until a future meeting.

As this concludes the programme for this meeting, I now declare the sixty-eighth meeting of the New England Cotton Manufacturers' Association adjourned.

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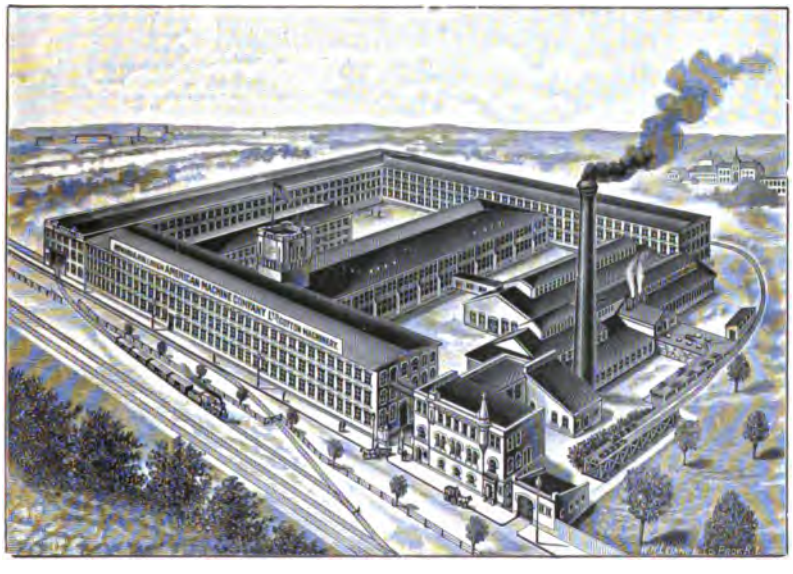

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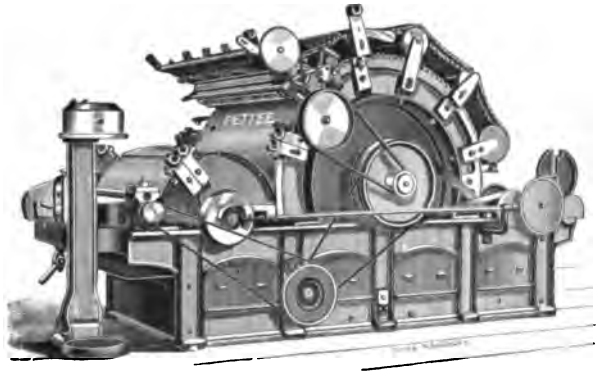

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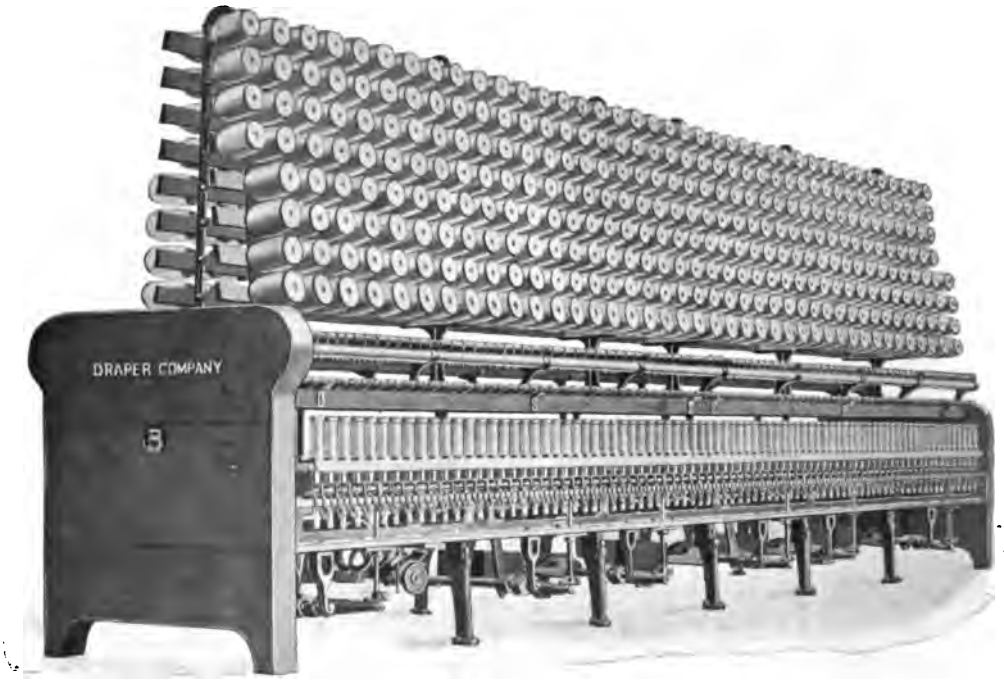

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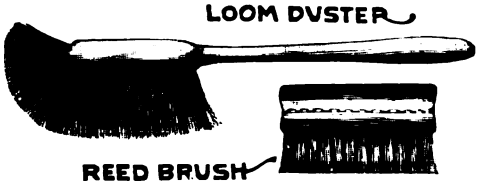

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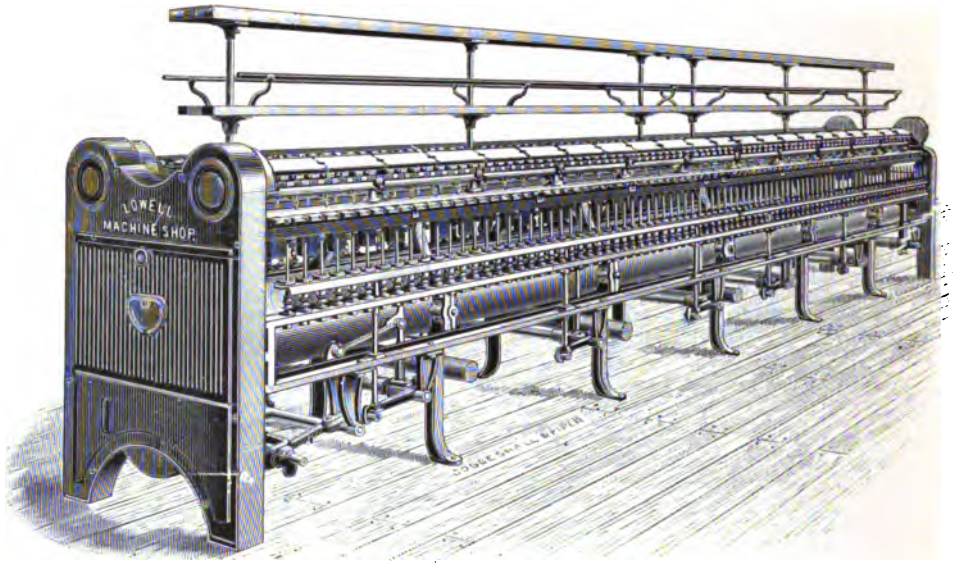

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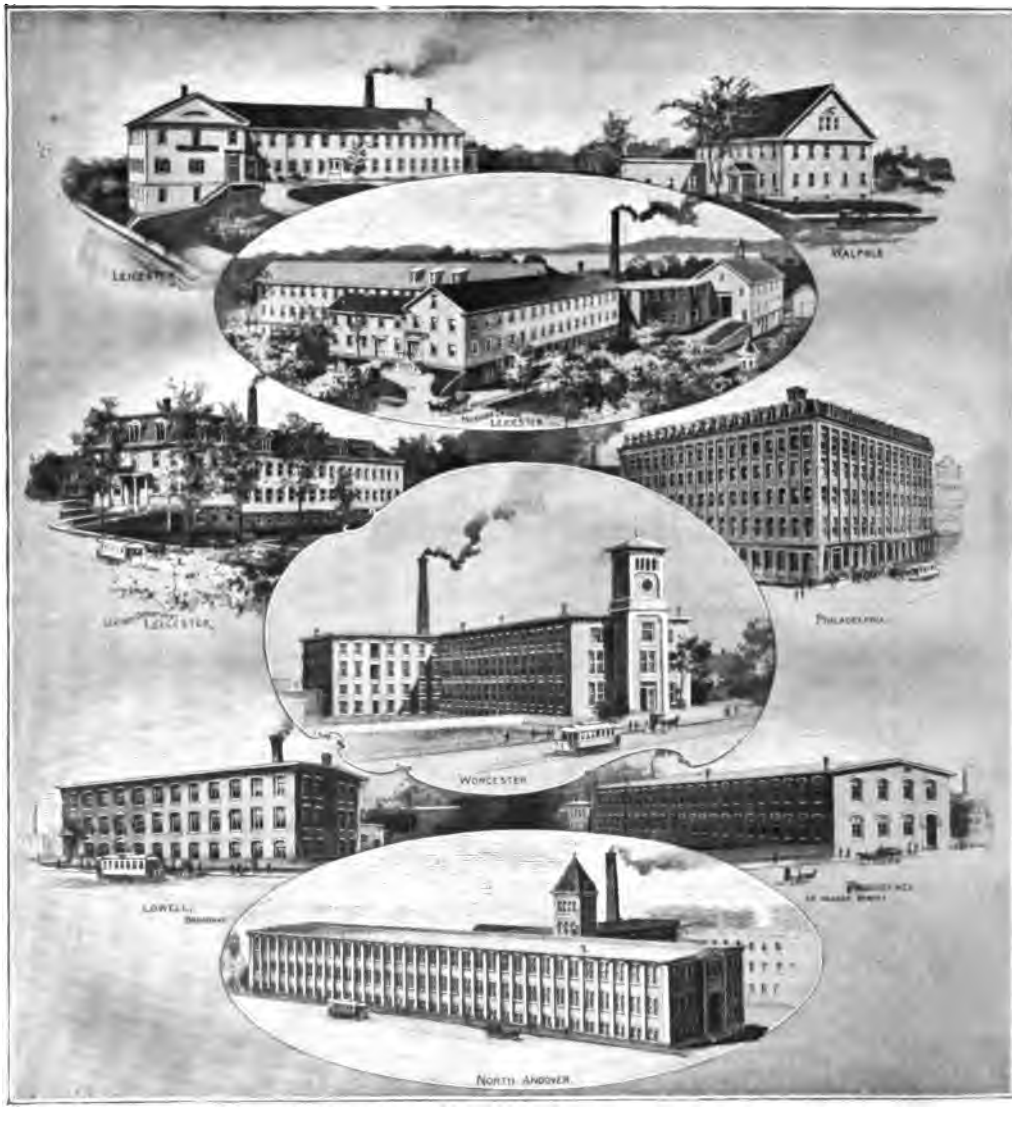

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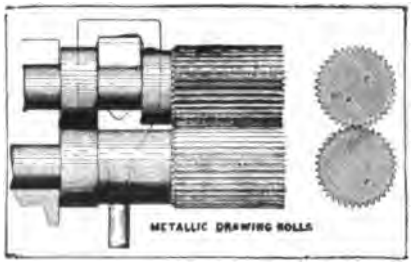

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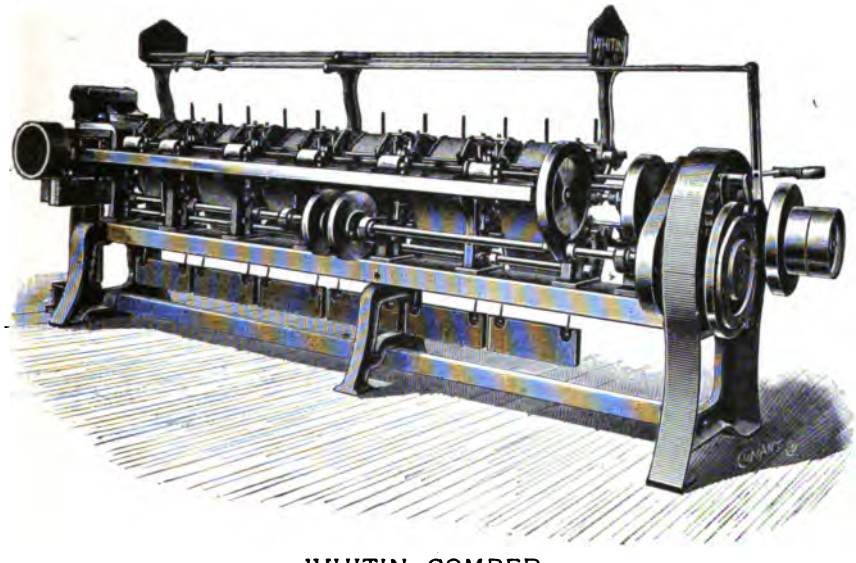

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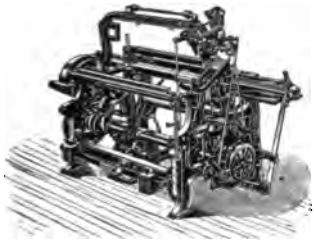

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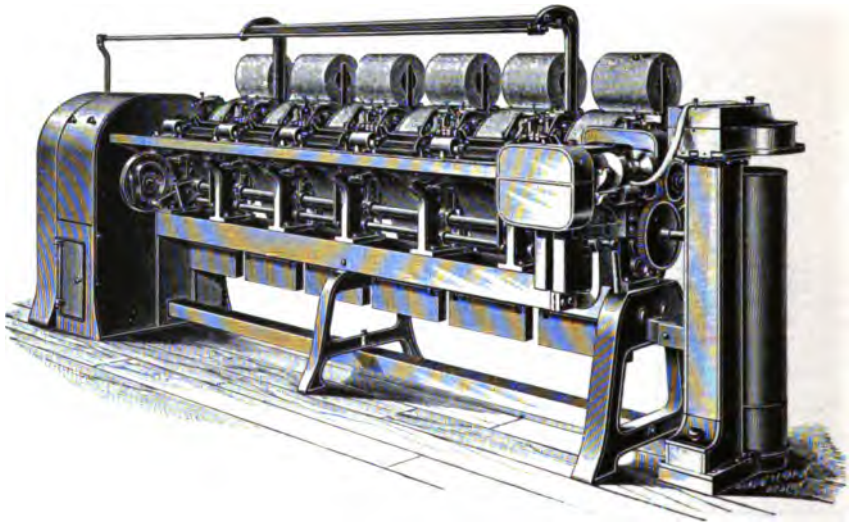

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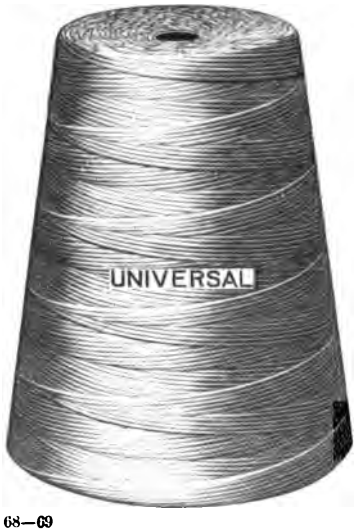

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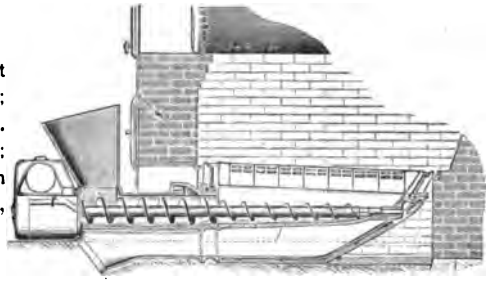

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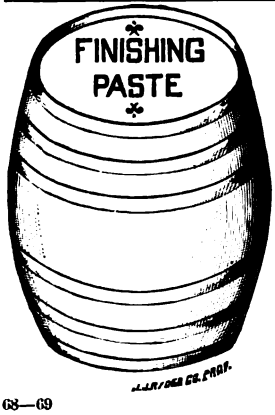

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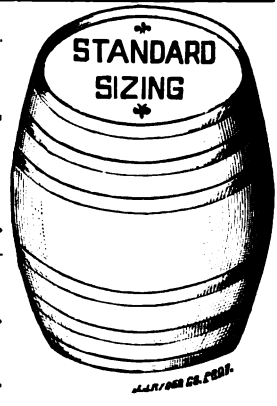

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